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The Resource Journal for IBM Micro Programmers

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PROGRAMMER'S Journal™

September/October 1989
Volume 7.5
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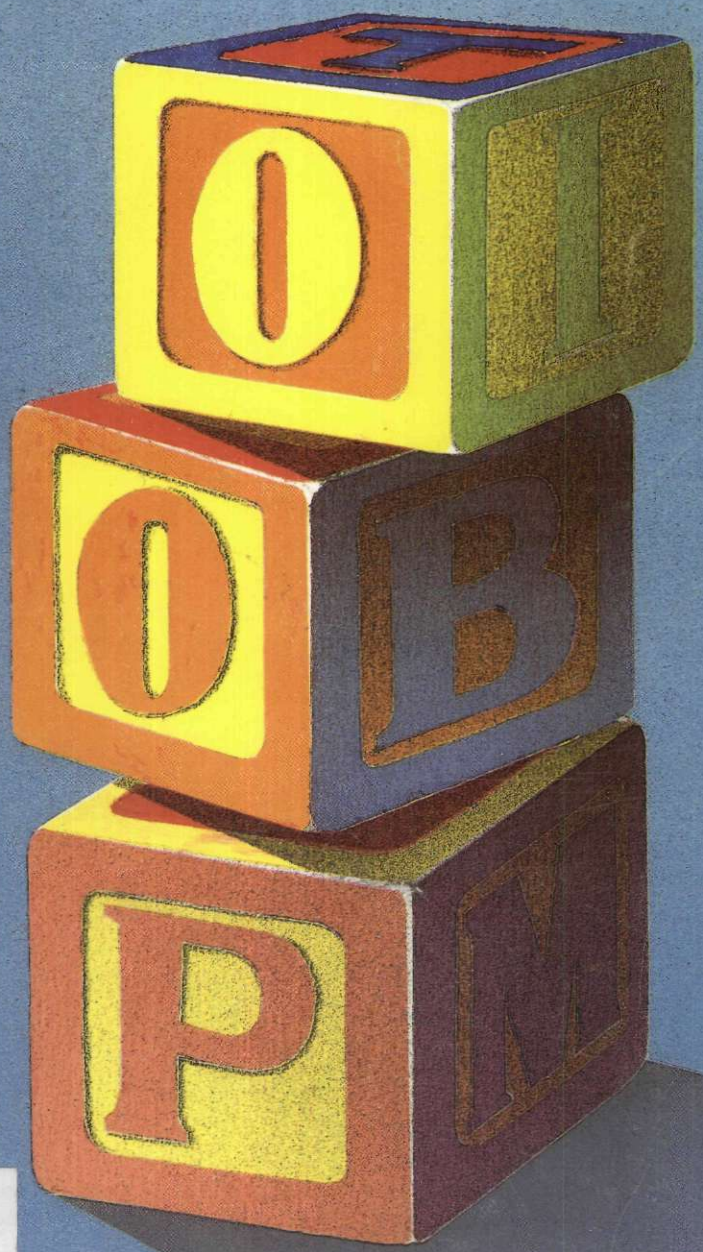
OBJECT-ORIENTED PROGRAMMING



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FROM C TO OBJECTS

BETTER C++ CODE GENERATION

More 256-Color VGA Resolutions

Enhancing the BGI in Turbo Pascal

Zortech and the ANSI C Standard

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Now it's easy to make your programs millions of times smarter.

More and more, programmers and work station builders are using DESQview as a development tool. The reason is simple. They can create powerful, multitasking solutions today for the millions of DOS PCs in use today. Solutions comparable to those promised for tomorrow by OS/2.

The API Advantage

Programmers who take advantage of DESQview's API (Application Program Interface) get access to the powerful capabilities built into DESQview —multitasking, windowing, intertask communications, mailboxes, shared programs, memory management, mousing, data transfer, menu-building and context sensitive help.

Bells and Whistles

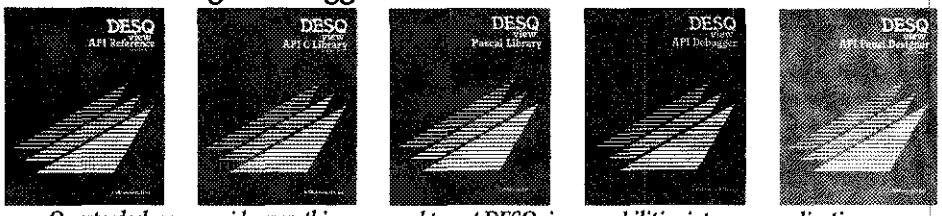
A program taking advantage of the DESQview API can spawn subtasks for performing background operations or new processes for loading and running other programs concurrently. It can schedule processing after an interval or at a certain time. It can use DESQview's intertask communications to rapidly exchange data between programs, share common code and data; or interrupt at critical events. It can use DESQview's menuing and mousing capabilities to create menus. And there's lots more it can do.

Some *of the applications under development right now using DESQview API Tools: CAD, medical systems, insurance, 3270 mainframe communications, network management, real estate, typesetting, point of sale, education, commodity trading, stock trading and online voting.*

80386 Power

Programmers can take advantage of the 80386's protected mode for large programs, yet run on DOS and multitask in DESQview—side by side with other 80386 and DOS programs. The breakthroughs that make this possible: DOS Extenders from PharLap Software and AI Architects and DESQview support of these DOS extenders.

A Complete Interactive Toolkit —Including a Debugger



Quarterdeck can provide everything you need to put DESQview capabilities into your applications.

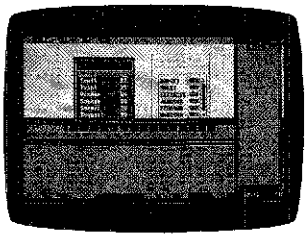
API Reference Manual The key to the power of the DESQview API, this manual contains all you need to know to write Assembly Language programs that take full advantage of DESQview's capabilities. And there's an 'include' file with symbols and macros to aid you in development.

API C Library Here are C language interfaces for the entire set of API functions. It supports the Lattice™ C, Metaware™ C, Microsoft® C, and Turbo C compilers for all memory models. Included with the C Library package is the API Reference Manual and source code for the library.

API Pascal Library The Pascal library provides interfaces for the entire set of API functions. It supports Turbo Pascal V4.0 and V5.0 compilers. Included are the API Reference Manual, source code for the library, and example programs.

API Debugger The DESQview API Debugger is an interactive tool enabling the API programmer to trace and single step through API calls from several concurrently running DESQview-specific programs. Trace information is reported symbolically along with the program counter,registers, and stack at the time of the call. Trace conditions can be specified to report only calls of interest.

API Panel Designer This interactive tool helps you design windows, menus, help screens, error messages, and forms. It includes an editor that lets you construct an image of your panel using simple commands to enter, edit, copy, and move text, as well as draw lines and boxes. You can then define the characteristics of the window that will contain the panel, such as its position, size, and title. Finally, you can specify the locations and types of fields in the panel.



The Panel Designer automatically generates all the DESQview API data streams necessary to display and take input from your panel. These data streams may be grouped into panel libraries and stored on disk or as part of your program.

More Tools are Coming Quarterdeck is committed to adding tools as needed by our users. To that end we have been working with Ashton Tate and Buzzwords International on dBASE III and dBASE IV translators. And in the works, we have BASIC and DOS Extender libraries.

If you'd like hands-on experience with the API Toolkit, write for information on our next API Conference, coming this August.

Bring New Power to DOS with the DESQview API Toolkit.

Quarterdeck

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THE NEW BENCHMARK IN PROGRAMMING PRODUCTIVITY

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The Resource Journal for IBM Micro Programmers

PROGRAMMER'S Journal™

Volume 7.5
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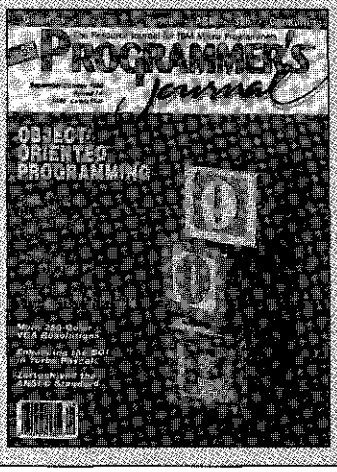

No, our cover art doesn't mean that Big Blue made a boo-boo. *OOP* means "object-oriented programming," a relatively new approach to programming that is just beginning to get the attention it deserves. In this issue of *PJ*, some of the best programmers in the field show you how to make child's play of object-oriented programming.

Artist:
Jarrett Jester

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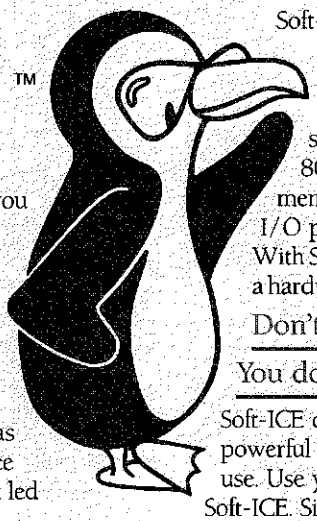

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Object-oriented programming (OOP) and object-oriented design (OOD) are apparently this year's buzzwords. Some folks predict that OOP languages will soon sweep functional programming languages into the past. Others argue that OOP will be the preferred approach for certain specific applications that fit the mold. In any case, lots of reasons are cited for the need to move to OOP languages and OOD concepts.

Information hiding and code reusability are often mentioned. Compared with the functional programming languages used in the past, data and objects (instances of data) become the central unifier. Code and data become commingled in the programming context. But clearly a strong impetus is the increasing complexity of the newer computer environments and systems—OS/2 with Presentation Manager, UNIX with X-Window, News, OSF/Motif, and Open Look graphical interfaces. OS/2 with PM has over 700 system calls to comprehend, a mind boggler for sure.

Most OOP languages may solve these complex problems easier than C or Pascal, but at the machine level, some performance penalty is usually inevitable. On slow CPUs with limited memory (older PCs), this performance reduction might be noticeable. But with the ever-higher CPU speeds and larger memory spaces, it is presumed that wringing out performance is no longer the issue for the user. The programmer's problem has become one of interfacing with such complex environments.

Meanwhile, Back at the Ranch . . .

While OOP may be the buzzword, both large and small firms are still churning out new or updated conventional programming products. Microsoft has recently released an updated DOS FORTRAN compiler and a combined QuickC and QuickAssembler. MetaWare and Lattice have released new versions of their C compilers. Both Borland and Microsoft are dueling it out with Turbo Pascal 5.5 and QuickPascal, both with OOP extensions. Microsoft has also released the Presentation Manager Toolkit, a much less costly version of the OS/2 SDK less the C compiler and assembler.

The DOS OOP market has until recently consisted of implementations of SmallTalk (Digitalk), C_Talk (CNS), and Actor (Whitewater Group). Other options now include Objective-C and Eiffel (a new OOP language from France currently on UNIX/386). An ever-increasing list of vendors—Zortech, Intek, Guidelines, and Glockenspiel (OASYS and Imagesoft)—offer C++ compilers. AT&T missed it scheduled June 30 deadline to release version 2.0 of C++. But clearly the PC C++ battle will be fought next year, when Microsoft and Borland will likely unveil their C++ offerings.

Back at the Video Palace

Before the dust has settled on new BIOS standards for the higher-resolution 800x600 VGA modes, Western Digital has begun sampling their 8514/A chip set. Several other vendors will soon follow. Just as the VGA begins to displace those massive numbers of EGA cards, the new IBM 8514/A-compatible video card will hit the streets. Meanwhile, Texas Instruments has completed the development of TIGA-340, and Microsoft has written fast TIGA drivers for PM and, presumably, Windows 3.0. This fall should be a busy video season.

Should You RISC It?

Spring saw the official introduction of the 80486 chip, the Intel i860 chip, and a score of powerful, low-priced RISC and CISC workstations from SUN, DEC, Data General, and others. By fall, we may actually see some of these new workstations rather than just samples. And by 1990, we should likely see machines using the new CPUs. The 80486 chip held few surprises. The math coprocessor moved on board, but no new instructions were added. Although current versions of the chip have some status bits reversed, these will be corrected before the 486 is released in a machine. Intel has clearly targeted 386 compatibility as foremost. This may give software developers a chance to "catch up" with hardware developments.

DOS extenders are becoming more entrenched in the PC marketplace. Both AutoCAD and VersaCAD for the 386 are available. The PC version of Interleaf Publisher has reduced memory needs from 6 to only 2 megabytes of memory using the Phar Lap DOS extender with the Virtual Memory Manager. OS/3 still appears far into the future, while EISA is still off to a slow start until fall COMDEX.

Intel has also been effective (with the 80386) breaking into the UNIX market once dominated by Motorola. Motorola has finally started to sample 50-MHz 68030s this summer (Definicon has a 50-MHz DSI coprocessor board running). But now the workstation vendors are targeting the high-end PC market with their low-cost machines. This should be an interesting show to watch. If you're fortunate enough to be in the memory business, it really matters not who wins. —*Steve* PJ

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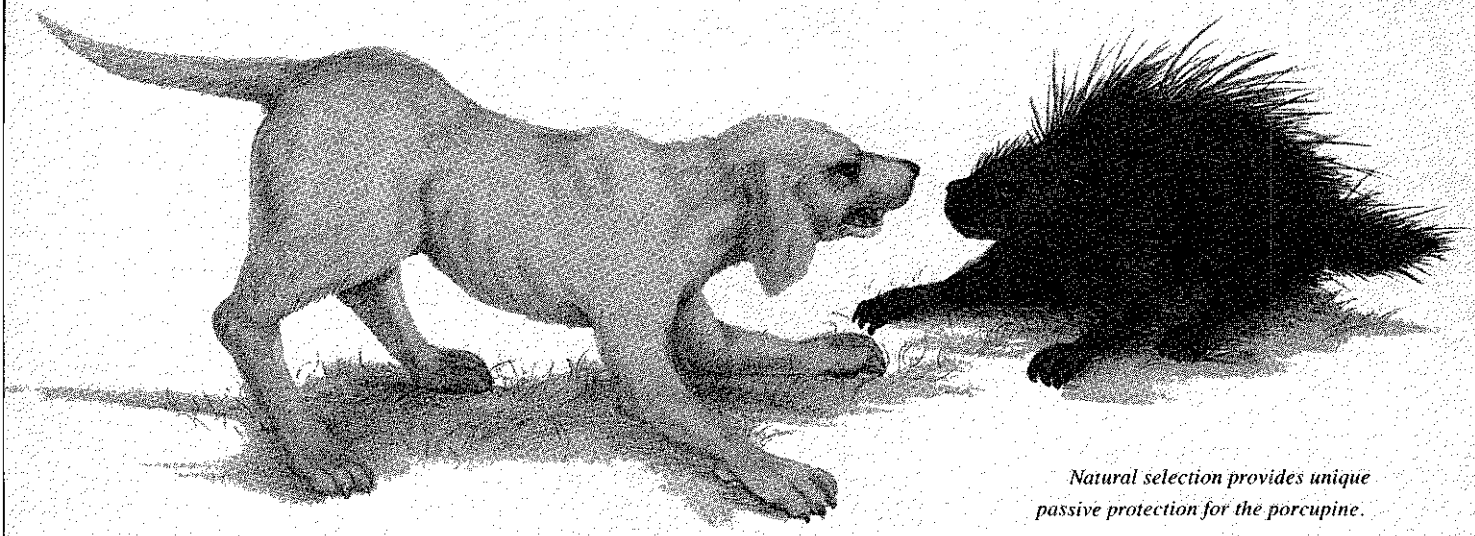
Software Developers



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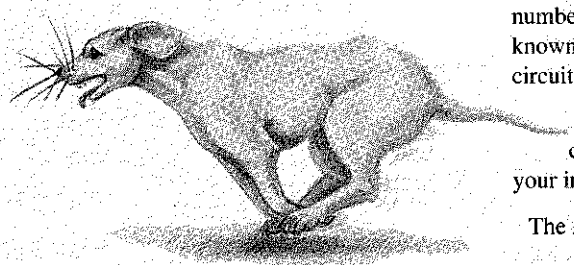

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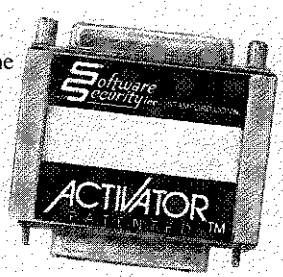

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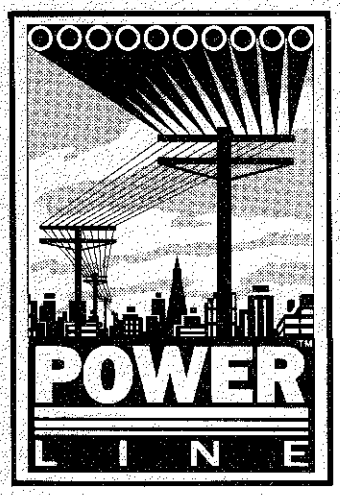

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On Neural Nets and Graphics

[NOTE: The following is a combination of two letters received from the writer.]

[5/4/89] I have a few comments on Waite and Hardenbergh's "Neural Nets" (*PJ* 7.3). First, the connectionist paradigm is even older than the authors report; the first published papers appeared in the 1940s as biological hypotheses to explain associative memory (e.g., Hebb, D. O., *The Organization of Behavior*, J. Wiley & Sons, New York, 1949).

Second, for a more leisurely introduction to the topic, I recommend Caudill's "Neural Network Primer" series, appearing at irregular intervals in *AI Expert* beginning in December 1987.

Third, the authors' statements, choice of an example network, and estimates of computer horsepower required may convince PC programmers not to explore this interesting field. Caudill's back-propagation network, described in *AI Expert* (June 1988), can be implemented practically on an underpowered 4.77-MHz 8088 machine.

Fourth, the author's definition of a training iteration may influence users to train once on the entire set of exemplars, then twice, etc. I have found it best to train repeatedly with one exemplar until the correct output is produced reliably, then with a second until the net can differentiate the two patterns, then with three, etc. I trained the Caudill example, a 35x4x8 net without biases or momenta, which maps 7x5 pixel bit maps for letters onto their ASCII codes, to nearly its theoretical limit in one afternoon, without automating the training. This example is certainly of real-world significance and offers hope for PC applications of neural nets if, as the authors warn, one can limit the size of the input.

[5/25/89] I'd like to thank Michael Abrash for his fine series, "On Graphics." I've used most of it. In the installment in *PJ* 7.3 is a code listing for an assembly version of Bresenham's line algorithm. I didn't believe that accumulating pixels at the cost of a jump was more efficient than saving the jump but performing more writes to video memory. I tested both versions on a 4.77-MHz NEC V20 machine with a Video Seven VEGA card. The accumulator version required an average of 5.32 seconds to draw 480 pixel lines corresponding to each of the 480 possible angles in the first octant. The jumpless version performed the same task in an average of 5.48 seconds. The difference amounts to 3.3 clocks per pixel in favor of the accumulator version. I also compared video-memory reads to those for ordinary RAM. I found a difference of about 26 clocks per byte read.

I've also always wondered when it is more efficient to shift by one rather than shifting by CL. I guessed the two methods were about even at four shifts. I tested both methods with the queue full and empty at the start of the operation and with three and four bytes to be consumed after the operation. In every case, shifting by CL was superior at three shifts, with execution times changing very little from one to four shifts. When shifting by one with the queue empty at the start, adding an additional shift cost exactly eight clocks. The two clocks required to execute a shift by one are insignificant relative to the eight or more required to fetch the two-byte instruction. A big reason for the surprising performance of shifting by CL is that it allows the queue to fill, three bytes for shifting once and four for shifting twice or more; whereas repeated shifting by one quickly depletes the queue.

As most instructions are queue depleters, as a general rule, the fastest assembly code will be that which executes the fewest bytes of instructions rather than the fewest execution clocks.

Tom Juntti
Whitewood, South Dakota

A Quick Strip Method

Please allow me to share with your readers an assembly language code-optimization trick I discovered recently. While writing a parsing routine, I needed a fast method of stripping spaces from a text string. The following code fragment is one method of accomplishing this:

```
        MOV     CX,STRING_LEN
TOP:    LODSB
        CMP     AL,' '
        JE      NEXT
        STOSB
NEXT:   LOOP    TOP
```

The problem with this code is that two jumps are made whenever a space character is encountered. The code fragment below is the optimization that I came up with:

```
        MOV     CX,STRING_LEN
        JMP     SHORT   TOP2
TOP1:   DEC     CX
        JZ      DONE
TOP2:   LODSB
        CMP     AL,' '
        JE      TOP1
        STOSB
        LOOP    TOP2
DONE:
```

I counted clock cycles from the LODSB instruction through the JE condition to the next LODSB instruction and calculated an eight-percent speed improvement for the second code. Timing tests revealed a range of five to eleven percent in speed improvement, depending on the ratio of space characters to other characters.

Adrian B. Crum
Fontana, California

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Abrash Trapped?

Although I have great respect for Michael Abrash's graphics, assembly programming, and writing skills, in "Fast Line Drawing for the EGA and VGA" (*PJ* Volume 7.3) I fear he fell into the assembly language trap (to use his word) when making his conclusions. His assembler code does indeed outperform his C code by a wide margin. However, he didn't give C a fair shake in comparison to assembler because he failed to implement the algorithm as skillfully in C, and also failed to use Jim Mackraz's suggestion in C.

To demonstrate the difference, I rewrote his EVGALINE.C and incorporated Jim Mackraz's suggestion. *[Interested readers may contact PJ's managing editor for a copy.]* Even though my C code is similar to Michael's assembler code and is more compact than his C code, I submit that I did not sacrifice clarity for speed. To keep the comparison fair, I (mostly) resisted the temptation to make obvious additional improvements. Yet, when compiled with Microsoft C 5.1 and timed on my AST Premium/286 and SOTA VGA/16, my C code is *2.3 times faster* than Michael's C code. (The difference when compiled with Turbo C 2.0 is not so great, owing to less-effective compiler optimization.)

Am I suggesting that C can *always* be just as fast as assembler? Of course not. Michael's assembler code is still over 70 percent faster than my C code, a difference that is not surprising given his great skill. However, less skillful assembler code might well have been slower. In my experience, good C code is easier for average programmers to produce than good assembler code, and the speed of good C code is comparable to the speed of good assembler code in most applications.

In conclusion, I don't agree that assembler is the *only* answer, even for graphics, although I do agree that a good algorithm alone is not a guarantee of good performance. Skillful programming and a good compiler are equally important.

By the way, another excellent reference that is more practical for EGA/VGA graphics programming is the *Programmers's Guide to PC & PS/2 Video Systems*, by Richard Wilton (Microsoft Press, 1987).

John Navas II
Dublin, California

MICHAEL ABRASH RESPONDS: De gustibus non est disputandum. *(For those few non-Latin-speaking programmers out there, that translates as "There is no disputing tastes.") As usual, everything John says is correct—but that doesn't mean I was wrong. To elucidate:*

John is bang-on right that I didn't give the C implementation a fair shake. I explained why in the article: Why spend time optimizing C when optimized assembly language is bound to be much faster? (By the way, while John's C implementation is certainly readable, it does reflect an expert knowledge of coding for speed in C. Honestly, how many programmers would think to OR *the result of* outp *with display memory, in order to avoid an immediate operand? Most programmers would also reflexively count up from 0 to the line length in for loops rather than using the more-efficient counting down.) That brings us to my second point, which is that the 70-percent advantage of assembly over John's fastest C implementation is still a tremendous advantage. My 386 machine at work is just about that much faster than my 286 machine at home—and believe me, I can tell the difference!*

Also, the assembly language line-drawing code itself is probably close to twice as fast as John's fastest C code. The missing 30 percent of that performance advantage is absorbed by a combination of display-memory wait states (about

Continued on page 10

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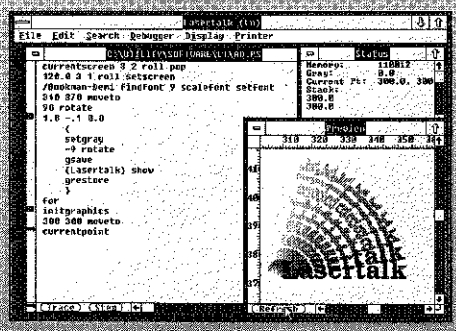

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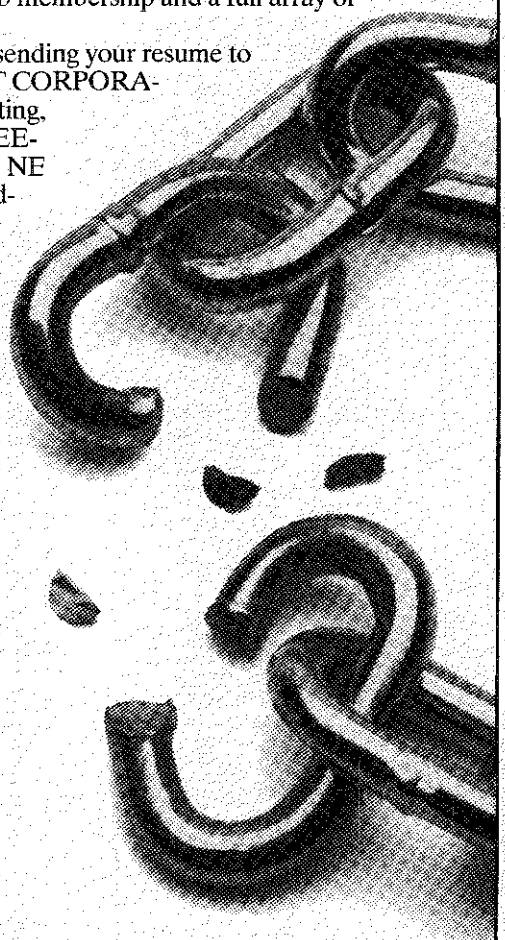

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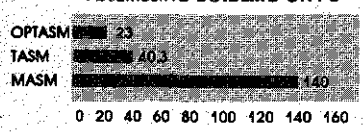

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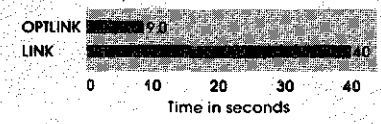

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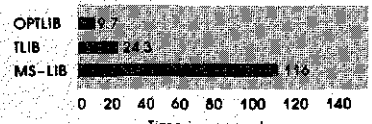

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three-quarters of a second on an EGA for the sample program), which take about the same amount of time for all versions of the line-drawing code, and by the overhead of the calling C code, which again is the same for all versions.

That's picking nits, though. What's important is that line drawing is the sort of low-level, critical function—basically a system function—that should be done with great care once and then used many times. That 70-percent increase doesn't just make one program faster—it makes every *program that uses line drawing faster, and that covers most graphics programs. Granted, not everyone can write good assembly language; one of the reasons I wrote the article is so that people who want good graphics performance but not the hassle of programming in assembly can speed up their programs. (And, honestly, have you ever known any graphics program that wouldn't benefit from running faster?)*

All that being said, John is still absolutely right that good C code is easier for average programmers to produce. No argument there. Heck, it's easier for anyone *to produce—I do most of my programming in C, and I don't know anyone who uses assembly for the bulk of his or her work. And, yes, good C code* is *comparable to good—not great, but good—assembly code in most applications, and often whatever difference exists between the two isn't worth the extra effort of assembly language.*

So what's to disagree about? Nothing, really—basically, we're just talking about different things. Maybe my mistake was in saying "Truly good PC code requires both a good algorithm and *a good assembler implementation." What I should have said was, "Superb, knock-your-socks-off, dazzle-and-delight-users and reuse-until-the-cows-come-home graphics code requires both a good algorithm* and *a good assembly implementation." If you're writing a one-time-only application, use whatever language gets the job done fastest and most reliably, as long as the code runs adequately well. If you're putting a program with less-than-instantaneous response and screen-update times out there into a competitive segment of the commercial market, or if you need—*not want, *but* need—*speed, use assembly language. If you're not up to writing that code, perhaps you should take up knitting. Or COBOL. Whatever. (That's a generic "you," not intended to mean John Navas, who has shown in past articles and letters that he is an excellent programmer and need not consider knitting.)*

In short, John is right: For most programmers, most of the time, C (or Pascal, or Modula-2—I'm no language fanatic) is a good choice. But I'm also

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right: To write the best code when nothing less will do, the best programmers use assembly language. And you know, I suspect that's exactly the sort of thing people read Programmer's Journal *for. Anyone can pick up a graphics book and write a tolerable line-drawing routine in C. Where do you look to get a fast implementation, though? I'd like to think the answer is* right here.

Anyway, reasonable people may disagree. John, thanks for (as always) intelligent and thought-provoking feedback.

Just Ask

I enjoy Michael Abrash's "On Graphics" series very much. His articles are clear, well structured, and fun to read. He gives a very good insight into the interior of graphics cards and their programming.

To my point of view, the description of higher 256-color resolution on the VGA *[PJ 7.1]* was one of his most exciting articles. Unfortunately, he restricted the program examples to the 320x400 mode, though 360x480 256-color mode seems to be much more interesting. I (and probably a lot of readers) would be glad to get further information about this mode in one of the following issues of *Programmer's Journal*.

Martin Althaus
Schwelm, West Germany

Michael provides just what you're looking for in his article in this issue. Readers may also be interested in Michael's new book, Power Graphics Programming, *a collection of the entire "On Graphics" series to date.*

Even More on Michael

I read with great interest Michael Abrash's "Measuring Performance" piece in the July/August issue. Several years ago I read the original *BYTE* article mentioned by Abrash, which described the method to generate high-resolution timings, and I wrote a simple package for my own use. This eventually evolved into a Shareware-distributed package that provides a multitude of high-resolution timer functions and supports popular C and Pascal compilers, with the current version (PCHRT v3.00) capable of timing hardware and BIOS interrupt service routines. I thought a few observations regarding this article might be helpful to those readers wishing to build on the routines listed.

The range of the timer can be expanded past 54 milliseconds by leaving interrupts enabled during the event to be timed and reading the DOS time-of-day data word as well as the 8253 timer chip. This alleviates the need to reset the timer chip before each timing and allows the system clock to function normally, while yielding a timer range measured in hours with microsecond accuracy. The design of a suitable data structure to hold these high-resolution time stamps can give the user the ability to have many different event timers running concurrently.

The coding of these timer routines need not be done in assembly language, as the majority of the popular high-level languages contain some type of function to read and write PC I/O ports. I have enclosed some simple Turbo Pascal code to illustrate how this might be done. The calculation of the elapsed time between two time stamps and the calibration of the timer system is beyond the scope of this letter but is not very difficult.

Two final comments: I have not found the delays Abrash used between 8253 chip I/O to be necessary, and, like the author of the original *BYTE* article, he never sets the 8253 timer chip back to its original state when all timing activity is concluded. I have rectified this in my sample code *[see the box above]*.

Thomas Leathley
Mt. Pleasant, Michigan

Something to C

Thank you for providing us with an opportunity to respond to Rex Jaeschke's article, "Lint Utilities" [*PJ* 7.4], where he summarized the history of Lint and reviewed Gimpel's PC-Lint and our C Programmer's Toolbox Volume II's CLint.

By and large, we agreed with Rex's review but were surprised that he did not also include a comparison/description of UNIX's Lint, since it is the granddaddy of all Lints. We agree that Lint and other supporting tools are extremely important in the software-development process: They save time and improve program quality. We also agree that documentation is extremely important. Unfortunately, as he noted, we did not update CLint's printed documentation in our last release—only the on-line documentation.

Though Rex seemed to advocate extensive documentation, including program-generated error messages, I personally believe that short and to the point is better. Who wants to wade through many pages of documentation before you can figure out how to operate a tool? (Yes, I know we have over 400 pages in our manuals, but you can do a lot simply with our on-line documentation.) Or how about wading through pages of warning/error messages

Code from Thomas Leathley's letter

```
Turbo Pascal high-resolution timer example. This timer reads the DOS time-of-
day data word and thus extends the range of the timer beyond 54 milliseconds.
Interrupts must be enabled during timing. The calibration routine, as well
as the routine to compute elapsed time between two high-resolution timestamps,
is left to the reader.

tphrt_type = record
               ticks : word;              { 838 ns 8253 timer ticks     }
               tocks : word;              { BIOS TOD 54.925 timer tocks }
             end;

procedure t_start;
{-----------------------------------------------------------------------------
 |  This procedure initializes the PC 8253 timer chip to mode 2 and calls    |
 |  the timer-calibration routine.                                           |
 -----------------------------------------------------------------------------}
begin
    inline(
            $B0/$34/                    { mov  al,00110100b }
            $E6/$43/                    { out  43h,al       }
            $2B/$C0/                    { sub  ax,ax        }
            $E6/$40/                    { out  40h,al       }
            $E6/$40                     { out  40h,al       }
          );
    t_calib;                            { call the calibration routine }
end;  { t_start }

procedure t_get(var timestamp : tphrt_type);
{-----------------------------------------------------------------------------
 |  This procedure grabs the current counts from the 8253 timer and the      |
 |  BIOS time-of-day clock. Interrupts are off during the timer reads,       |
 |  then back on.                                                            |
 -----------------------------------------------------------------------------}
var
    bios_tod : word absolute $0040:$006C;
begin
    inline($FA);                        { interrupts off }
    port[$43] := 0;
    timestamp.ticks := port[$40];
    timestamp.ticks := timestamp.ticks + (port[$40] shl 8);
    timestamp.tocks := bios_tod;
    inline($FB);                        { interrupts on }
end;  { t_get }

procedure t_stop;
{-----------------------------------------------------------------------------
 |  This procedure disables 8253 mode 2 and sets 8253 mode 3 counting,       |
 |  which is what the 8253 was doing before we meddled with it. . . .        |
 |  Invoke when all timings complete.                                        |
 -----------------------------------------------------------------------------}
begin
    inline(
            $B8/$36/                    { mov ax,00110110b }
            $E7/$43/                    { out 43h,ax       }
            $2B/$C0/                    { sub ax,ax        }
            $E6/$40/                    { out 40h,al       }
            $E6/$40                     { out 40h,al       }
          );
end;  { t_stop }
```


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that have similar, lengthy descriptions? When an error condition occurs, the exact error location (file, line, *and* character) should be identified and a self-explanatory error message generated. Certainly, there will be error messages or conditions that require more-complete descriptions than can be incorporated in a program-generated error message. These exceptional conditions should be documented in the manual with possible workarounds or solutions.

Finally, I would like to mention that in the middle of September, we will be releasing the next version of the C Programmer's Toolbox (Rev2.0). The release includes all-new documentation (which should satisfy most of Rex's complaints) and a number of significant tool enhancements. Some of CLint's enhancements include selective enabling/disabling of error messages, more control over **typedef** checking, and support for a number of nonstandard (and undocumented) compiler features (e.g., "//"). These new enhancements complement our continuing support for ANSI C, Microsoft's C, and Borland's C, as well as for many of the engineering-workstation Cs.

Other major tool enhancements include virtual-memory support for CFlow (program hierarchy) and CXref (cross reference), now enabling quick and easy processing of *unlimited* program sizes (the symbol tables now automatically overflow to disk); more options and controls for CPrint, our C source code beautifier/reformatter; and more options in PMon (performance monitor) for intercepting and monitoring a program's external environment, including BIOS. In addition, many of the other supporting tools have also had significant enhancements. With this release, many more of the tools are now the best available on any development platform.

We wish to thank all of those people who have worked with us (including [*PJ* Editor M. Steven Baker] on CFlow) and helped us to make our tools the best and most useful available. We will continue to strive to provide the best possible C development environment.

W. T. Sumerlin, Jr.
MMC AD Systems
Milpitas, California

Getting the Time of Day

I got my copy of the July/August *PJ* today, and lo! not one, but two, articles on my favorite topic of timing. Each article contains half of the answer to getting 840-ns.-resolution timing up to about 138 days, more or less, if my memory serves me well. So, let's put it all together.

Think of the time of day as a 48-bit number, in which the high-order 32 bits are the time of day as maintained by BIOS, and the low-order 16 bits consist of the current count read from 8253 timer 0. So, reprogram 8253 timer 0 in mode 2 per Michael Abrash's approach. Then, to get a current time value, inhibit interrupts, snatch the current BIOS clock value (as Ethan Winer did), and read in the current 16 bits from timer 0.

Voila! Put it all together, and you have 48-bit time of day accurate to 840 ns., the resolution of the 8253. Or almost. The 16 bits of the 8253 must be inverted, and so they are monotonically ascending, like the rest of the time of day. Now, save the 48-bit time value, and enable interrupts. Inhibiting interrupts guarantees that there will be not be a timer interrupt while putting together the time-of-day value. Occasionally, there will be a lost BIOS tick in this whole process, as there always is in DOS when the timer interrupt cannot be serviced because of servicing a higher-priority interrupt. More often than not, a BIOS tick is lost when there is either a disk I/O with a large sector count in process when the timer counts to zero or a lengthy handshake between the PC and a LAN card.

Now, to find the elapsed time between any two time-of-day readings, do 48-bit subtraction on the two numbers. Very accurate, and the system clock isn't disturbed by frequently resetting the 8253. If

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the result of subtracting the earlier from the later time value is negative, you need to add a correction factor of at least one BIOS tick to compensate. Then, keep track of the number of lost ticks, and apply a correction factor equal to *n* lost ticks.

I worked this out from the Intel 8253 spec several years ago and then corroborated it with an article by Ralph Brickner in *PC Tech Journal* from back in 1984. Ralph did a two-article set. The first described a home-grown profiler, and the second reviewed the state of the art at the time. We've used the algorithm described above in one commercial product and are about to incorporate it into a second. The only fly in the ointment is interpretive BASIC, which reprograms timer 0 itself to count down four times per 54.925 ms. So, you can't get accurate timings of interpretive BASIC. Oh, well.

Rick Naro, the designer of the Inside! profiler series, used roughly the same approach to do timings. By now, Michael Abrash probably has used one version or another of Inside!, which Ethan Winer reviewed very favorably in *PC Magazine*, and rightfully so.

I am amazed at whatever thoughts were in the mind of the engineer who wrote the 8253 timer routines for the original PC BIOS. I'll never understand why mode 3 was chosen instead of mode 2!

Overall, this was a good issue, full of interesting ideas and topics.

Ben Myers
Spirit of Performance, Inc.
Harvard, Massachusetts

MICHAEL ABRASH RESPONDS: Great feedback. Actually, I'm well aware of how to time periods greater than 54 ms, but (a) precision is lost if interrupts are turned back on, and (b) there's only so much room in my column in PJ. *And, yes, Inside! is very good (I discuss it in this next issue). I must say that I think that a 32-bit timer tick count is sufficient (once you're over a minute you might as well forget about messing with the 8253!). Also, there is a bit of a synchronization problem with reading the 8253 and the timer count simultaneously: It can introduce 54 ms of inaccuracy.*

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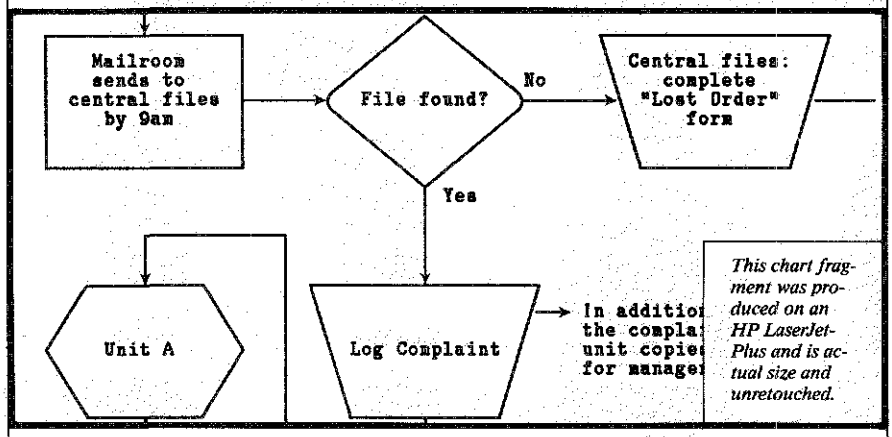

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A Technological Schism

by

Hal W. Hardenbergh

Most of us who read the newspapers know that the Moslem world is mostly divided into two sects, Sunnites and Shiites. I once read that the schism was based on a dispute over the ownership of a garden—not the Garden of Eden, but just a little garden like one any suburbanite might have. Because a guy named Martin Luther didn't like certain then-prevailing practices of the Catholic church, I attended a Protestant Sunday school as a child.

I don't think anybody really cares anymore about a dinky little garden, but you do not see the Sunnites and Shiites reuniting. I suspect that Martin Luther might find today's Catholic practices more to his liking were he still around, but we do not see the Protestants and Catholics reuniting.

Like some others, I changed religions when I grew up. For many years now, I have venerated the electron, both in its manifestation as a particle and in its manifestation as a wave. Last year I moved to Silicon Valley, where many of my fellow votaries are located.

Regrettably, my religion has in recent years suffered a schism between us steadfast CISC devotees of truth and the misguided followers of the false heresy, RISC. My purpose in writing this article is to briefly review the history of this schism and to provide an unbiased description of its future course.

It was all Ivan Sutherland's fault. He introduced Lynn Conway, who worked for Ivan's brother Bert at Xerox PARC, to Cal Tech's Carver Mead. Conway and Mead developed a systematic way to design VLSI circuits and more or less invented the concept of the silicon foundry. Designing VLSI chips became so easy, and fabricating them became so cheap, that even a college class could design one and have it built.

Conway and Mead's book was published in 1980. The next year, UC Berkeley's David Patterson had his class design a computer chip. Even with Conway and Mead's techniques, that computer had to be simple, since a class does not have years to work with. So, they reduced the instruction set to fit the time constraints—and they left out a lot of useful stuff, such as an interrupt handler.

Because of the extreme simplicity of the chip, they were able to make it 32 bits wide. Remember, this was 1981. The newest and hottest chip in the commercial world was the 68000, which had only a 16-bit data bus. Bus bandwidth counts. The simple chip was completed in 1982, and it worked! That it was fast was perhaps an unexpected bonus.

This chip, which Patterson called a RISC, was deservedly considered a success. A college class had produced a real, working microcomputer chip that could do loads and stores and Boolean operations and shifts and conditional branches. Students were jumping up and down and (this being the '80s) exchanging high fives. *They* could build a CPU!

RISC wasn't really all that new. Other folks had worked on the concept, including John Cocke in Building 801 at IBM's Thomas Watson Research Center, in Yorktown Heights, New York, in the mid '70s. (Some people think that Seymour Cray's designs, such as the 1964 CDC 6600, are actually RISC computers.) But Cocke didn't talk to reporters, and Patterson did; so most folks associate Patterson with RISC.

Patterson repeated his success with another class. Now there were *lots* of students jumping up and down. In the natural course of time, these students graduated and diffused into industry.

The next thing you knew, announcements of wonderful new commercial RISC chips, all with 32-bit data buses, began to appear. And *much* later, some of them actually became real. (Some of them are *still* in the process of becoming real.) Because they had 32-bit buses, they were all quite fast. But a funny thing happened in the years that had passed: Motorola and then Intel switched their CISC designs to 32-bit data buses, and suddenly the RISC supporters noticed the RISC performance advantage was evaporating.

(The AMD 29000, which is just becoming real, *should* be a lot faster than the 68030, which will soon be replaced by the much-faster 040. But it isn't. The 030 does integer multiplies 45 percent faster than the 29K! A new CPU should be twice as fast as one that is two years older, or the designers aren't doing their job.)

In the past couple of years, commercial microcomputers based on RISC microprocessors have appeared on the scene from Hewlett-Packard, MIPS, and Sun. A very peculiar thing happened: RISC technology was expected to be cheap because the CPUs are simple and hence small. But those first commercial RISC microcomputers wore price tags ranging from $76,000 to $260,000. Why?

Nineteen eighty-seven was a terrific year for personal computer types. We had enough memory (typically a megabyte), and that memory was fast enough for our CISC processors. But 1987 was a mixed year for the folks who were rolling out the first RISC microcomputers. RISC uses many 32-bit instructions, which must operate very quickly. This means that RISC machines need twice as much memory as CISC machines to hold the same program. And they all ran UNIX. In 1987, UNIX had been "improved" to the point that even CISC-based machines, such as the Sun 3/260, needed 4 megabytes to get any useful work done. That meant the RISC machines needed 8 megabytes. And the RISC

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A review: Semiconductor memory capacity is doubling every 1.5 years, as it has for the last 20 years. CPU speed is doubling every 2 years, as it has for the last 42 years. Memory bus bandwidth is doubling every 3 years, as it has for the last 20 years. (By *bandwidth* I mean the ability of the memory system to get data to the CPU fast enough to keep the CPU running at full speed. This is sometimes called *latency*.)

These are all exponential increases, which plot as straight lines if we use a logarithmic vertical axis and a linear horizontal time axis. But the slopes are different, and that means the lines cross someplace, as shown in the figure, which is normalized for constant CPU performance. Ten years ago we had memory speed to burn but were really hurting for memory capacity.

machines needed to fetch all those instructions very quickly, which meant they needed memory that was twice as fast as that of an equivalent CISC machine. In other words, all of the RISC machines needed very large, very fast memory systems.

Do you suppose that we have discovered why RISC-based microcomputers were being sold for $76,000 to $260,000 when *excellent* 386-based machines, comparably equipped except for that excessively large and fast memory, could be had for $10,000?

Why, you may ask, did Cocke and Patterson settle on RISC if it has substantial memory-speed disadvantages? Well, in 1975 and again in 1981 the memory-bandwidth problem that plagues today's RISC machines did not exist (check the graph). The memory-size problem, which is a two-to-one hit for RISC, was not really a problem in the 1975 IBM environment, where low markups did not prevail. And Patterson was developing a CPU chip, not a complete computer. *What* memory problem?

That brings us almost up to date. What's happening now? Well, Intel has announced both the 860 and the 486, which are RISC and CISC chips, respectively. The 486 represents everything that is evil to the unreasoning RISC camp followers. Why? Well, RISC chips always execute fundamental operations—load and store, for example—in fewer clock cycles than CISC machines, such as the Intel *X*86 series. Don't they?

Ahem. The SPARC requires two clocks to load and three to store. The 486 requires one clock to load and one to store. And they both run at 33 MHz. *What* inherent RISC superiority? In fact, which is the RISC and which is the CISC? Aren't RISC chips fast load–store devices?

My article "Memory Trends" was published in *PJ* 6.3 (May/June 1988). While it was being written, Cypress Semiconductor, a maker of fast static RAM, had 25 percent of its fabs sitting idle. Six months later, the fabs were fully booked and the backlog was growing. Why? Because the use of high-speed static RAM in personal computer caches skyrocketed. Who woulda thunk it? Oh, yes—that article ended with the following sentence: "You are going to see true 64-bit microprocessors *soon*."

Such coincidences. The 860 just happens to have a 64-bit bus. It has an internal data cache with a 128-bit bus and an internal instruction cache with a 64-bit bus. That makes an internal cache bus width of 192 bits! For that reason, the 860 is today's fastest microprocessor. Too bad it won't run MS-DOS.

Lucky guesses? No, I was just extrapolating from long-established trends. One predicts a deviation from these trends at one's peril. It's been *two* years since the 10-MIPS SPARC was announced, and Sun isn't shipping 40-MIPS versions yet. Sun was going to double SPARC's performance *every* year, remember?

Just *What* Is a RISC Chip?

In 1982, a RISC chip was simple, potentially cheap, and faster than then-current CISC chips, for the reasons discussed earlier.

Today, a 32-bit RISC chip is neither simpler, cheaper, nor faster than its CISC counterparts. The disputed garden that originally caused the RISC–CISC schism did in fact exist in 1982 but has now vanished. However, religious schisms historically are not "cured" when the original causes vanish. There is an *enormous* number of persons and companies out there who have a vested interest in RISC.

All of us know that minicomputers are faster than personal computers and that mainframes are faster than minicomputers. In past years, that statement could be made with confidence; today one squirms a bit—the lines are blurring. In

Transistors get smaller and hence faster as time passes. But both memories and CPUs use the same transistor technology; so this has nothing to do with the relative speed of memories and CPUs. Let us hypothetically assert that transistor speed is constant.

As time passes, memories get bigger. That means that they get slower, because the address decoder has more gate delays. As time passes, CPUs get bigger, which means they get faster. The disparate trends of memory and CPU speeds will continue, because both memory and CPUs are going to continue to get bigger (especially in transistor count).

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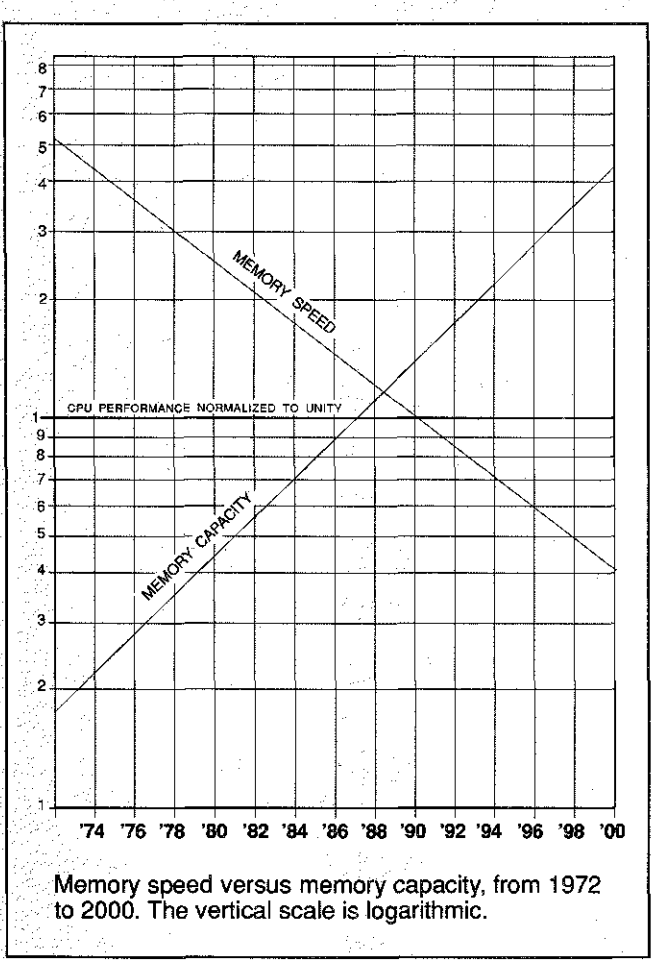

Memory speed versus memory capacity, from 1972 to 2000. The vertical scale is logarithmic.

recent years, a microcomputer was something made from one or two commercial chips, and a minicomputer was made from five or six custom gate arrays.

The Cypress SPARC chip set has five or six chips. The Edgecore (formerly Edge) implementation of the 680X0 instruction set has five or six chips. The upcoming Nexgen implementation of the 386 instruction set has five or six chips. Are these microprocessors or minicomputers? You tell me.

Motorola is vanishing from desktops. Sun has just now released its first 33-MHz 030 machine, for $40,000. H-P has been selling its 33-MHz 030 machine for $44,000. Motorola makes all the 50-MHz 030 chips anyone would want, and *nobody* is shipping a desktop computer based on that part. Apple's 020 and 030 offerings are ludicrously slow, perhaps because Apple has a monopoly on the Mac OS. Meanwhile, three companies announce 33-MHz 386 machines, and reviews of these machines appear in magazines, *before* Intel starts shipping the parts!

Motorola's 50-MHz 68030 screams, and the forthcoming 68040 will be to the 486 what the 030 was to the 386. But I greatly fear that I will never be able to purchase a full-speed 030 or 040 machine to take home. I *know* that I will be able to do that with a full-speed 486 machine, and *soon!* Maybe it's time for me to start learning Intel assembly language....

Intel's *X*86 series has vanished from embedded applications, which do not have to run 1-2-3 but do have to be easily programmed. The 32-bit microprocessor market was $1.1 billion in 1988. Intel and Motorola each had 43 percent, National's CISC chips had another 5 percent, and everybody else had 9 percent (Integrated Circuit Engineering Corp., Scottsdale, Arizona). "Everybody else" includes CISC makers Zilog (80000), AT&T (32100), and various Japanese CISC TRON chips. I'm looking hard to find the RISC share of the market, but it's apparently hiding under a speck of dust.

Right now, Intel has the world's fastest microprocessor, the 860. It also has the world's fastest 32-bit microprocessor, the 486. There are rumblings of a new version of the 960 that will give the 860 a run for its money. How is this possible? In the first quarter of calendar 1989, Intel spent $83.2 million on research and development—that's $665 million per generation of CPUs. Intel can afford to develop *several* high-performance CPUs concurrently, even if the cost per CPU exceeds $100 million.

Want to buy stock in a RISC startup?

A Look at the Future

The 68040 will be the last of the 32-bit micros that have any pretention of high performance. The 586 and 68050 will both have 64-bit data buses. Look for the first 128-bit micro in 1994 and the first 256-bit micro in 1999.

Workstation manufacturers have begun to notice the jillions of 386 machines running AutoCAD, OrCAD, and 1-2-3. If the thought of those packages running on 486 machines at under $10,000 doesn't scare them, it should. A mini-war has just started over low-end UNIX machines. So far, DEC, Sun, and Data General are slugging it out. *All* of the workstation manufacturers are going to lose until they notice that *X*86 machines are sold across a retail countertop by salespersons who are behind on the payments on their 1978 Fords. Workstation salespersons drive new Porsches, belong to country clubs, and send their kids to private universities. That's why you can buy a 33-MHz 386 personal computer for under $10,000 but you have to pay $40,000 for a 33-MHz 68030 machine from a workstation vendor. (The cheapie UNIX stations you read about are diskless, and so they are totally useless as personal computers.)

Has anybody noticed that younger Compaq (1988 profits: $255 million) is growing a lot faster than Sun Microsystems (1988 profits: $66 million)?

There Was No Choice!

YEAR	STATIC		DYNAMIC	
1971	??	(256x1)	1103	(1Kx1)
1974	2102	(1Kx1)	??	(4Kx1)
1977	2114	(1Kx4)	4116	(16Kx1)
1980	6116	(2Kx8)	4164	(64Kx1)
1983	6264	(8Kx8)	41256	(256Kx1)

In past years, the CPU determined the system speed. So there were lots of CPUs to choose from, but just one static and one dynamic RAM. In future years, the memory will determine the system speed. There will be many memory variations, but only two CPUs will be used: the *X*86 and the 680*X*0.

Let me make this clear: You will buy computer performance the same way you buy steak—you get more if you pay more. Fancy CRTs or fancy cuts are more expensive. There will be a market for $2,000 computers and $5,000 computers. The more expensive computer will *always* be faster, because more dollars buys faster RAM, larger RAM, or a little of both. CPUs will not be chosen for speed, because they will all be capable of outrunning the RAM. Instead, CPUs will be chosen to run a particular software base. And that means that all CPUs that are not code museums are going to vanish silently into the night.

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The Intel 586 will be announced about September 1991. It will have a 64-bit data bus and Harvard internal caches with 128-bit cache widths, and it will use 2 million to 2.2 million transistors. By December 1992, Intel will be using a 0.65-micron process to make this chip, and it will be running at 60 to 75 MHz. Cypress, which makes very fast static RAMs, has a profit margin of over 20 percent. Sun Microsystems, wildly successful vendor of UNIX systems, has a profit margin of 5 percent.

The perverse RISC fallacy was neither perverse nor a fallacy in 1981. Circumstances have dramatically changed since then. "RISCites" have invested tens of millions of dollars, years of their time, and untold quantities of personal pride and such into the RISC concept. Until recently, they cheerfully admitted that RISC devices require *more* memory and *faster* memory. Why do I expect this candor to wane?

A variety of CPUs will continue to be made—Texas Instruments will be selling the 4-bit TMS1000 into the next century—but only in embedded applications. There will be only two CPUs used in personal computers or personal workstations.

A $5,000 personal computer will have a big, slow memory system for folks who are databasing or a small, fast memory for computation-intensive applications. This is why you are going to see a variety of specialized RAMs. Not many personal computer owners are going to want to set aside 4 megabytes so that they can run UNIX or OS/2. MS-DOS will continue to be the most popular operating system because it is memory efficient.

Let me emphasize this: In past years, your only decision was how much memory to buy. In future years, you will have to decide both how big *and* how fast. This year, 80-nsec, 4-meg DRAMs; 35-nsec, 1-meg Hitachi DRAMs; and 20-nsec, 256K Toshiba static RAMs are all entering production and all wear essentially the same price tag. You will pay a 4*x* premium per bit for the 35-nsec part and a 16*x* premium per bit for the 20-nsec part.

Today, a complete 33-MHz 386 personal computer with a megabyte of fast DRAM and high-speed, static-cache RAM starts at about $8,000. I think it would cost at least $12,000 to build an equivalent machine based on the 50-MHz 68030. Strictly speaking, it will be possible in the near- and mid-term future to buy computers whose memory systems will run the CPU at full speed, but the price tag will continually increase. If we limit the price tag of a "personal" computer to, say, $10,000, then it is already (in 1989) not possible for memory to keep up with the 68030.

UN*X Report #37,617

Some of you know that I used to write a newsletter, parts of which were published in *PJ*. In late 1981, the "experts" were predicting that UNIX would soon take over the high-end personal computer market. Beginning in early 1982, I continually disputed that. I even correctly predicted that AT&T's UNIX PC would be a marketing disaster of major proportions. This is 1989, and UNIX still has 5 percent of the market. But hark! The *Wall Street Journal* published a report predicting that UNIX will have 38 percent of the market in 1993. Predictions of UNIX's imminent ascendency occur repeatedly, like sightings of Elvis or UFOs.

I now use UNIX at work. I document using **vi** and **nroff**. I test image-processing systems that run UNIX. I've learned the hard way that you can destroy the UNIX system disk data by turning off the power instead of following a lengthy software-shutdown procedure. The user interface is incredibly complex and unfriendly. *This* is a system that is going to take over the personal computing market? Running on a RISC CPU that requires an inordinate amount of the computer world's scarcest resource, memory bandwidth?

An Exercise for the Student

Plot the cost of a personal computer that would run the fastest then-available *X*86 CPU with no wait states over the past eight years. Now, project that curve forward over the next eight years. Interesting, isn't it? (A computer with cache does not really have *zero* wait states, but it's the best practical approximation to that ideal.) PJ

Hal W. Hardenbergh is a senior hardware engineer who sometimes programs. Hal works at Vicom Systems, Inc., in San Jose, California.

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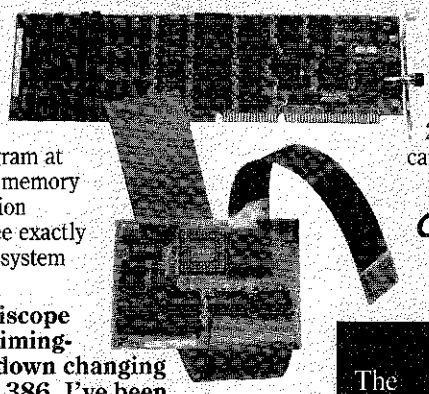

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Source Code Version Control

by
Ken Cunliffe

For the past year, I have managed the development of a new computer-aided design (CAD) system in the C programming language. Multi-CAD™, a part of XYSYS International's CAD-Access™ system, serves as a bridge between the PC and the mainframe CAD systems used by most large manufacturing companies. The system runs on IBM PC-ATs and compatibles and offers seamless data interchange between PCs and a wide range of mainframe CAD systems. The package is targeted at companies with mainframe CAD/CAM/CAE systems that wish to add inexpensive seats and also at companies not presently using CAD/CAM/CAE that need to interface with customers or suppliers who already have mainframe systems. The Multi-CAD source code includes hundreds of source files and hundreds of thousands of lines of code.

As sections of the program were constantly being passed from one programmer to another, one of the biggest problems we faced early in our development effort was making sure that everyone was working on the correct version of the code. For example, on several occasions, when one programmer went on vacation, other people on the project lost track of what the vacationer had been doing and incorporated an earlier version of the software into their work. While we tried to avoid having two people work simultaneously on one section of code, lead-time requirements sometimes made this necessary. The absolute worst-case scenario—the product goes out to the customer without part of an update—never happened, but we came close enough to make us very nervous.

Version-Management Control

After encountering serious coordination problems, we adopted a version-management tool, with excellent results. Version management seems to have been introduced with UNIX, and it has been one of the more useful tools supplied on UNIX systems. For those who are unfamiliar with the concept, a *version-management system* helps to manage the development and maintenance of software or other types of files by tracking changes made to those files. All changes are stored in an archive directory. Each time changes are made to a file, a new revision of the file is created, and the archives are updated. Only changed information is stored, helping to conserve disk space.

A set of changes that were made to a file to take it from one revision to another is referred to as a *delta*. Each revision is given a unique identifier, and so any revision of the file can be regenerated using its identifier. A group of file revisions that make up a version of a product is called a *thread*. The version-management system that we use automatically generates four predefined threads, called the *active, latest, test,* and *working threads*: The active thread of the product is made up of the currently extracted versions, the latest thread is the most recently created revision of each file, the test thread is the version of the product that is currently being tested, and the working thread is the current release of the product. The user is free to assign other threads as desired.

Here's how the version-management system we chose, the Seidl Version Manager (SVM), from Seidl Computer Engineering, solved the problem. Whenever a programmer edits a file, he or she must first "check out" that file from the version-management system. Rather than selecting from a mishmash of files on diskettes with cryptic identifiers, the programmer will, in most cases, simply tell the version-control system to select the latest thread. That revision is extracted from the archives and placed in the work directory by the version-management system. After editing the source file, the programmer "checks it in," or places it in the archives. During the update process, the version-management system computes the changes made from the base revision and creates a delta for this new revision. The version-management system ensures that everyone is working on the latest version of the program (unless we intentionally decide to do otherwise) and thus saves me a tremendous amount of time and worry.

Simultaneous Development

Prior to installing version management, we also faced severe problems when we had to maintain simultaneous development efforts at certain stages of our programming effort. Parts of our program are required to run on Prime mainframe computers, at the request of a major customer. This client realized that time could be saved by off-loading some particularly CPU-time-intensive sections of the program from the PC. Because of time constraints, we simultaneously developed the Prime and PC versions of the program, incorporating the Prime environment changes into our main PC product and creating a central generic source code from which the Prime version can be regenerated quickly whenever the program is updated.

Program logic for the two systems is identical, but there are key differences in the file-handling systems. The main difference is that the Prime system inserts a counter at the beginning of each data record. Since this is the wrong structure for the PC that will be processing the data, it is necessary to turn off the counter facility for a direct-access file.

The adaptation for the Prime was the responsibility of one programmer.

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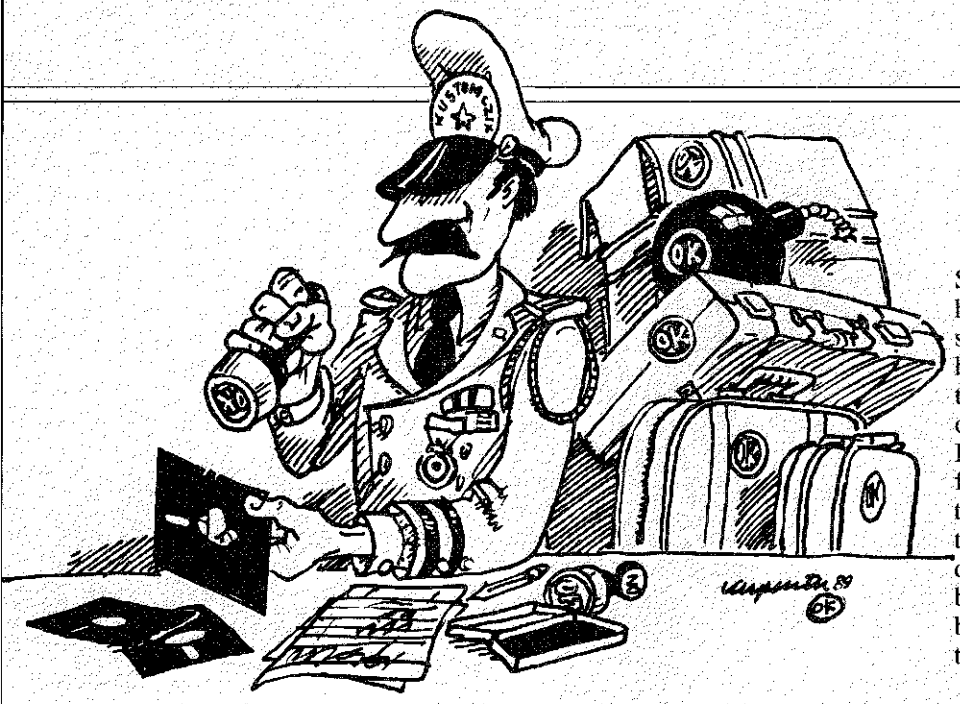

After a section of the program was running on the PC, he would take it, install it on the Prime, add the necessary code, and debug it. While this was going on, other programmers were making changes to the PC version; thus, it was necessary to manually merge the PC code with the revised Prime version—a task that was time-consuming and prone to error. This process frequently had to be performed at least twice for each section of code, because the PC sections were often revised enough to require revisions in the Prime code.

Version management greatly reduced the time required for the merging process described above. When a section of the code is near completion on the PC, we invoke the version manager's revision-branching feature to create two simultaneous lines of development (or threads, in version-management terminology). Working on one thread, our Prime programmer adds the necessary file-handling routines; working on the other thread, our PC programmer continues to fine-tune the program. As soon as the Prime programmer has completed his or her work, the version manager automatically merges the two development threads.

Occasionally, simultaneous changes may conflict. For example, one developer may delete lines 10–20 while another may modify line 15. Our version-management system would detect the conflict and call out both sets of changes to me so that I could resolve the issue.

Before we installed our version-management system, the need to perform simultaneous development created the potential for another, very embarrassing, mistake: Suppose that we had received an order for both Prime and PC versions midway through the process described above, at a point when the PC version had been changed and debugged but the changes had not been merged into the Prime version. Under our old system, a misguided person with good intentions could very easily have selected the latest tested Prime and PC versions to build the product. The product probably would not have worked, because the two versions would have been incompatible.

Now, using the version-management system, once we have proven out a product version, whether for the PC or the Prime, we define it as the working version of the product. When the version-manager system is called on to generate a version, it will automatically select the working version, which, in our scenario, would be the earlier versions of the Prime and PC products. Version management thus ensures that we always ship the latest proven version of our product.

Managing Variations

Another problem that we faced prior to installing version management was the need to manage a wide variety of variations of our program. For example, our Multi-CAD product offers dozens of optional menuing systems that can make the user interface simulate the user's mainframe system of choice. Since the program features on-line help, each menuing system must be associated with its own slightly different help system. We have two documentation people who are responsible for developing the on-line help systems. During in-house testing, we frequently found that the programmers developing the menuing systems were using either the wrong help system or one that was outdated—the menuing system had been completed, but the disk hadn't been carried across the hall and put on the correct machine.

The version-management system, in combination with a local area network, easily resolved this problem. When we first began using version management, each programmer worked on a stand-alone PC. After using the version manager for a while, we realized that we could improve our operations even further by tying them all together on a development network. We use a Sun Microsystems host, with a large hard disk and a tape backup unit, as the file server. Now, the documentation programmers simply place the latest update on the network file server, and the version manager automatically associates it with the correct menuing systems.

Creating Makefiles

When I first got involved with the project, we were manually creating dependency files (also known as makefiles). In the process of simultaneously creating a mainframe version of the program, we had to keep track of any additional files used by the Prime version. This was not the easiest task: Since we used a UNIX-style make utility, in which each dependency statement is independent of the other dependency statements, it is almost impossible to determine the structure of the program by reading the dependency file.

This problem was solved by integrating our version-management system with make- and dependency-tracking utilities (also from Seidl), making it possible to automatically reconstruct any product version with a single command. With our dependency-tracking utility, updating a

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dependency file to include information about files that we've added to our system became a simple task. The input data used by our dependency-tracking utility is called pre-DDL, which, in its simplest form, can be a list of filenames that do not even need to include suffixes. All we have to do is add the name of the new file used by the Prime version of the code to the pre-DDL file. The dependency tracker automatically creates a new dependency file, which can be used by the make utility to build the system.

We recently discovered an additional benefit of Seidl's dependency-tracking utility when we converted from Lahey FORTRAN and Lattice C to Microsoft compilers. This could have been a very time-consuming task had we still been generating dependency files by hand: We would have had to update each one manually, and it would have taken a fair amount of time to change the errors made through inability to read the cryptic dependency files. With the dependency tracker, all we had to do was change a few parameters, and all of our dependency files were automatically updated to reflect the move to Microsoft. Simultaneous programming took place with no downtime.

Making Backups

The version-management system has also relieved us of the headache of making frequent manual backups of our source files. Prior to the installation of this system, we had a disk crash that cost us dearly. After this occurred, we became very diligent about backing up files but found ourselves saddled with a tedious job, one that ate up a considerable amount of time that could have been better spent on productive programming.

The version-management system protects us from accidental or deliberate misuse, media failure, communication errors, power loss, and other disasters by providing automatic backups at any time interval that we specify. The version manager will archive only files that have been changed since the last archive unless we specify that *everything* is to be saved. This makes archiving a very simple task and ensures that it will be done often.

The backup methods employed are virtually "bombproof." First, a temporary file is created in the same directory as the original archive file. The primary portion of the temporary filename is the same as the original archive filename. (This ensures that the temporary file is on a nonvolatile medium.) Next, the original archive file is copied to a backup directory and then deleted. Finally, the temporary file is renamed to become the new archive file. Every record in archive files contains a CRC checksum, which is validated each time the file is accessed. If data appears to be corrupted, the user is notified so that the problem can be quickly corrected. Since moving to this system, we have not lost a single line of code.

Maintaining Revisions

Version management provides yet another important benefit: the ability to regenerate any version of our product. In the past, we spent a considerable amount of time saving and labeling each revision that was made because of the possibility that a future editing effort might turn out to be infeasible. Without this tedious effort, a potential disaster—reaching a blind alley and being unable to locate the previous revision—is always right around the corner. The version-management system maintains for each project a complete revision history of each source file, documentation file, dependency file, and so on. Any revision of any file may be extracted from the archives. This feature allows programmers to backtrack to any previous revision for any reason. Revisions may be extracted from the archives by any of several criteria (including revision number, version label, time stamp, or revision ID) and placed in a work directory.

The version-management system's revision-history feature comes in handy in other ways, too. For example, suppose I notice that a program is running significantly slower than it did before. I'd like to know why the change that slowed the program was made so that I can make an intelligent decision as to whether or not it was really necessary. If the programmer is around and remembers why he or she made the change, there's no problem—but suppose the programmer is on vacation, has left the company, or simply can't

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remember. This is why it's so important to me to have a record of who made the change, when it was made, why it was made, and so forth.

We used to accomplish this by producing text files on a word processor and saving them on the same disk that held our source files, but the version-management system maintains a very good audit trail for our project while taking almost no time away from our programming effort. Each time a revision is made, the version manager automatically records the time and date it was made, the user who placed it in the archive, and the revision from which it was derived. The version manager also prompts the user for a brief comment on why the change was made. All this information is stored with the revision and can easily be retrieved as an on-screen or printed report.

In conclusion, the version-management and associated product-generation utilities (which use Seidl's Version Manager and Make and SMKgen utilities) form a very efficient file clerk. Version management has eased our project-management chores and increased our code portability, productivity, and archiving security. It has also freed me to spend my time where it should be spent: managing. PJ

Ken Cunliffe has served as software manager with XYSYS for the past four years. Previously, he was technical director with CADSTEEL in Stockport, U.K. He studies electronic engineering at the Bolton Institute of Technology in the United Kingdom.

Version Management Vendors

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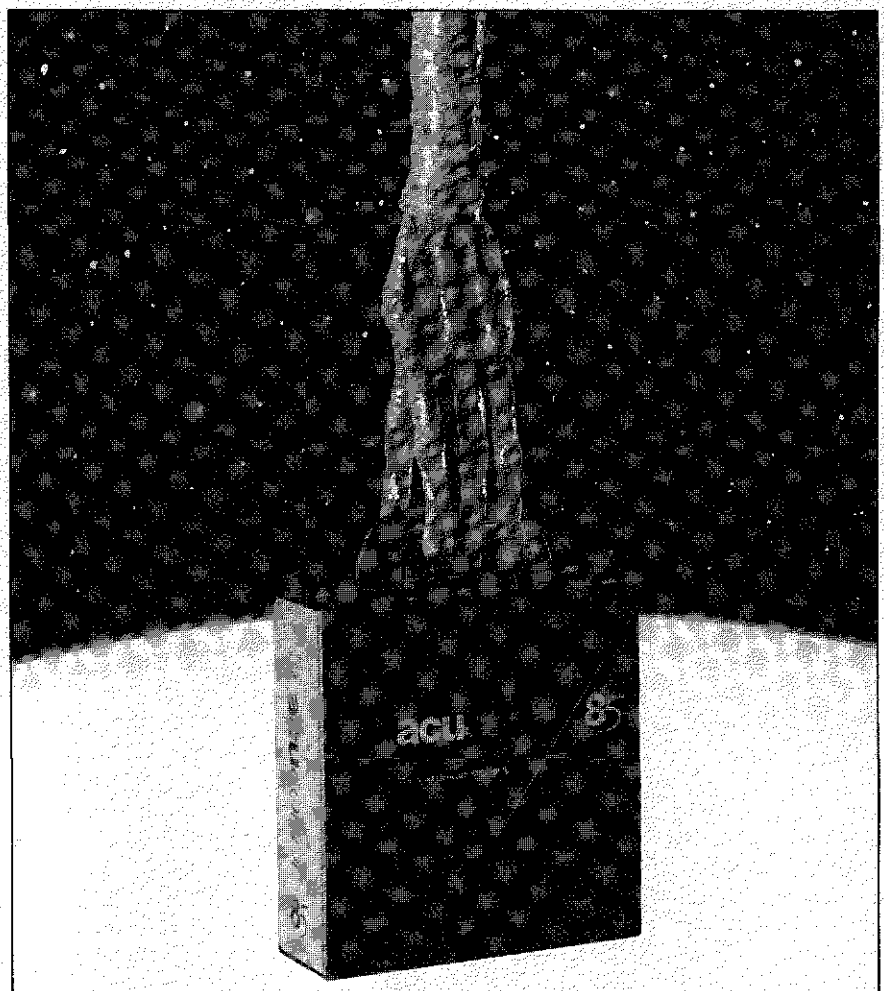

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Still-Higher 256-Color VGA Resolutions

by
Michael Abrash

Installment 14: In which we crank standard VGAs up to 360x480 256-color resolution, exceeding IBM's official 256-color resolution by a mere 170 percent, and also look at a way to pin down that ever-present bugbear of PC graphics programming—performance.

Several installments ago, we learned how to coax 320x400 256-color resolution out of a standard VGA. At the time, I noted that the VGA was actually capable of supporting 256-color resolutions as high as 360x480, but I didn't pursue the topic further, preferring to concentrate on the versatile and easy-to-set 320x400 256-color mode instead.

I got more feedback on that installment than on any other in a long time, illustrating once again that nothing fascinates graphics programmers like superior color–resolution combinations (especially undocumented ones). One particularly useful item came from John Bridges, who sent along a complete mode-set routine for 360x480 256-color mode, which he has placed into the public domain. John writes, "I also have a couple of freeware (free, but not public domain) utilities out there, including PICEM, which displays .PIC, .PCX, and .GIF images, not only in 360x480x256, but also in 640x350x256, 640x400x256, 640x480x256, and 800x600x256 on SuperVGAs. PICEM is in version 1.9b and can be found on all the above systems." (I've edited the quote slightly; John sent the information via MCI Mail, which tends to induce the dropping of certain parts of speech and punctuation.)

In this column, I'm going to combine that mode-set code with appropriately modified versions of the dot-plot code from the earlier 256-color installment and the line-drawing code from two installments back. Together, those routines will make a pretty nifty demo of the capabilities of 360x480 256-color mode.

I'll also look at Paradigm's Inside! Turbo C performance-analysis software. While that's not directly related to graphics, on the PC—with its limited processor power and bizarre graphics adapters—assembler, performance, and good graphics go hand in hand. Timing software like Inside! Turbo C, used regularly, can teach you more about creating good graphics programs than any number of books and articles. Why? Because every graphics program has unique performance characteristics, and only by measuring can you determine true performance.

In sum, we'll be exploring both higher 256-color resolution and ways to improve performance. That's a neat package, for we'll be approaching graphics from both ends: better appearance and better performance. Let's get started!

Extended 256-Color Modes

When last we left 256-color programming, we had found that the standard 256-color mode, mode 13H, which officially offers 320x200 resolution, actually displays 400, not 200, scan lines, with line doubling used to reduce the effective resolution to 320x200. By tweaking a few of the VGA's mode registers, we converted mode 13H to a true 320x400 256-color mode. As an added bonus, that 320x400 mode supports two graphics pages—a distinct improvement over the single graphics page supported by mode 13H. (However, we also learned how to get *four* graphics pages at 320x200 resolution, should that be needed.)

I particularly like 320x400 256-color mode for two reasons: It supports two-page graphics, which is very important for animation applications, and it doesn't require changing any of the monitor-timing characteristics of the VGA. The mode bits that we changed to produce 320x400 256-color mode are pretty much guaranteed to be the same from one VGA to another, but the monitor-oriented registers are less certain to be constant, especially for VGAs that provide special support for the extended capabilities of various multiscanning monitors.

All in all, those are good arguments for 320x400 256-color mode. However, the counter-argument seems compelling as well: Nothing beats higher resolution for producing striking graphics. Given that, and given that John Bridges was kind enough to make his mode-set code available, I'm going to look at 360x480 256-color mode next. However, bear in mind that the drawbacks of this mode are the flip side of the strengths of 320x400 256-color mode: only one graphics page, and direct setting of the monitor-oriented registers. Also, this mode has a peculiar and unique aspect ratio, with 480 pixels vertically (as many as high-resolution mode 12H) and only 360 horizontally. That makes for fairly poor horizontal resolution and sometimes-jagged drawing. On the other hand, the resolution is better in both directions than in mode 13H, and mode 13H also has an odd aspect ratio; so, it seems a bit petty to complain.

The single graphics page isn't a drawback if you don't need page flipping, of course, and so there's not much to worry about there: If you need page flipping, don't use this mode. The direct

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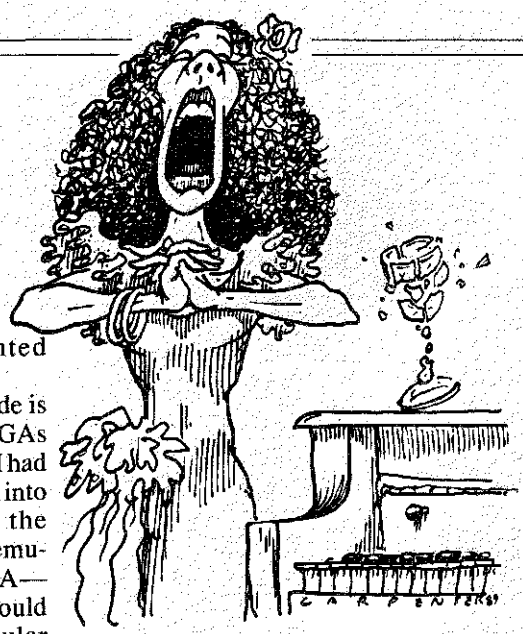

setting of the monitor-oriented registers is another matter.

I don't know how likely this code is to produce problems with clone VGAs in general; however, I did find that I had to put a Video Seven VRAM VGA into "pure" mode—where it treats the VRAMs as DRAMS and exactly emulates a plain-vanilla IBM VGA—before 360x480 256-color mode would work properly. Now, that particular problem was due to an inherent characteristic of VRAMs and shouldn't occur on Video Seven's Fastwrite adapter or any other VGA clone. Nonetheless, 360x480 256-color mode is a good deal different from any standard VGA mode, and while the code in this article runs perfectly well (in my experience), I can't guarantee its use on any particular VGA–monitor combination, unlike 320x400 256-color mode. Mind you, 360x480 256-color mode *should* work on all VGAs—there are just too may variables involved for me to be certain. Feedback from readers with broad 360x480 256-color experience is welcome.

The above notwithstanding, 360x480 256-color mode offers 64 times as many colors and nearly 3 times as many pixels as the original Color/Graphics Adapter color-graphics mode, making startlingly realistic effects possible. No mode of the VGA, documented or undocumented (at least none that I know of), offers a better combination of resolution and color—even 320x400 256-color mode has 26 percent fewer pixels. In other words, 360x480 256-color mode is worth considering. Let's have a look.

360x480 256-Color Mode

I'm going to start by showing you 360x480 256-color mode in action, after which we'll look at how it works. I suspect that once you see what this mode looks like, you'll be more than eager to learn how to use it.

Listing 1 contains three C-callable assembly language functions. As you'd expect, **Set360x480Mode** places the VGA into 360x480 256-color mode. **Draw360x480Dot** draws a pixel of the specified color at the specified location. Finally, **Read360x480Dot** returns the color of the pixel at the specified location. (This last function isn't used in the example program in this article, but it is included for completeness.)

Listing 2 contains a modification of the Turbo C line-drawing code I discussed back in installment 12 (*PJ* 7.3). The code has been altered to select 360x480 256-color mode and to cycle through all 256 colors that this mode supports, drawing each line in a different color.

The first thing you'll notice when you run this code is that the speed of 360x480 256-color mode is pretty good, especially considering that most of the program is implemented in C. In general, drawing in 360x480 256-color mode can sometimes actually be *faster* than in the 16-color modes, because the byte-per-pixel display-memory organization of 256-color mode eliminates the need to read display memory before writing to it to isolate individual pixels.

The second thing you'll notice is that exquisite shading effects are possible in 360x480 256-color mode; cone-shaped sections of lines blend into one another remarkably smoothly, even with the default palette. The VGA allows you to select your 256 colors from a palette of 256,000, so you could, if you wished, set up the colors to produce less detail but still-finer shading. (We'll get to reprogramming the palette someday—there's so much to do with the VGA!)

The one thing you may not notice right away is just how much detail is visible on the screen, because the blending of colors tends to obscure the superior resolution of this mode. Each of the four rectangles displayed measures 180 pixels horizontally by 240 vertically. Put another way, each *one* of those rectangles has two-thirds as many pixels as the entire mode-13H screen—in all, 360x480 256-color mode has 2.7 times as many pixels as mode 13H! As mentioned above, the resolution is unevenly distributed, with vertical resolution matching that of mode 12H but horizontal resolution barely exceeding that of mode 13H. But resolution is hot stuff, no matter how it's laid out, and 360x480 256-color mode has the highest 256-color resolution you're likely to see on a standard VGA.

Now that we've seen the wonders of which our new mode is capable, let's take the time to understand how it works.

How This 256-Color Mode Works

In discussing 360x480 256-color mode, I'm going to assume that you're familiar with my discussion of 320x400 256-color mode that appeared in *PJ* 7.1; if not, get hold of that issue (January/February 1989) and read it. The two modes have a great deal in common, but I don't want to bore faithful "On Graphics" readers and use up this always-too-small space by repeating myself.

360x480 256-color mode is essentially 320x400 256-color mode stretched in both dimensions. Let's look at the vertical stretching first, since that's the simpler of the two.

480 Scan Lines: A Little Slower

There's nothing particularly unusual about 480 scan lines—standard modes 11H and 12H support that vertical resolution. The number of scan lines has nothing to do with either the number of colors or the horizontal resolution; so, converting 320x400 256-color mode to 320x480 256-color mode is a simple matter of reprogramming the VGA's vertical control registers—which control the scan lines displayed, the vertical sync pulse, vertical blank-

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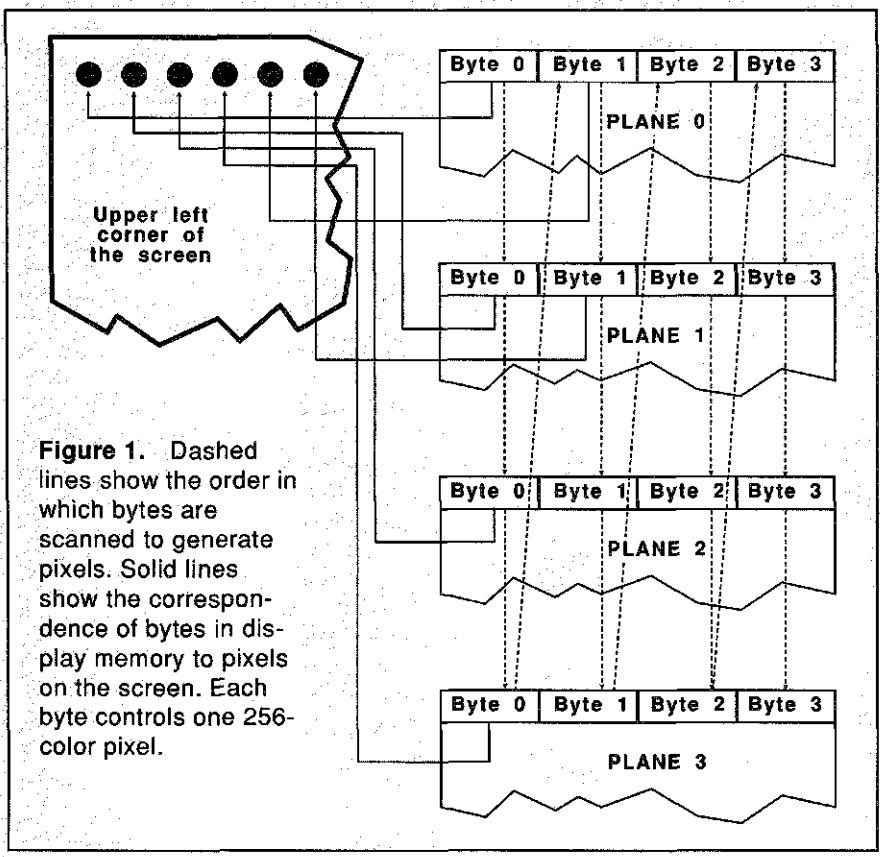

Figure 1. Dashed lines show the order in which bytes are scanned to generate pixels. Solid lines show the correspondence of bytes in display memory to pixels on the screen. Each byte controls one 256-color pixel.

ing, and the total number of scan lines—to the 480-scan-line settings and setting the polarities of the horizontal and vertical sync pulses to tell the monitor to adjust to a 480-line screen.

Switching to 480 scan lines has the effect of slowing the screen-refresh rate. The VGA always displays at 70 Hz, *except* in 480-scan-line modes; there, owing to the time required to scan the extra lines, the refresh rate slows to 60 Hz. (VGA monitors always scan at the same rate horizontally; that is, the distance across the screen covered by the electron beam in a given period of time is the same in all modes. Consequently, adding extra lines per frame requires extra time.) A rate of 60 Hz isn't *bad*—that's the only refresh rate the EGA supports—but it does tend to flicker a little more and so is a little harder on the eyes than 70 Hz.

360 Pixels per Line: No Mean Feat

Converting from 320 to 360 pixels per scan line is more difficult than converting from 400 to 480 scan lines per screen. None of the VGA's graphics modes supports 360 pixels across the screen—or anything like it; the standard choices are 320 and 640 pixels across. However, the VGA *does* support the horizontal resolution we seek, 360 pixels, in 40-column text mode.

Unfortunately, the register settings that select those horizontal resolutions aren't directly transferable to graphics mode. Text modes display nine dots (the width of one character) for each time information is fetched from display memory, while graphics modes display just eight dots per display-memory fetch. (Although it's a bit confusing, it's standard terminology to refer to the interval required for one display-memory fetch as a "character," and I'll follow that terminology from now on.) Consequently, both modes display either 40 or 80 characters per scan line; the only difference is that text modes display more pixels per character. Given that graphics modes *can't* display nine dots per character (there's enough information only for eight 16-color pixels or four 256-color pixels in each memory fetch, and that's that), we'd seem to be at an impasse.

The key to solving this problem lies in recalling that the VGA is designed to drive a monitor that sweeps the electron beam across the screen at exactly the same speed, no matter what mode the VGA is in. If the monitor always sweeps at the same speed, how does the VGA manage to display both 640 pixels across the screen (in high-resolution graphics modes) and 720 pixels across the screen (in 80-column text modes)? Good question. The answer is that the VGA has, not one, but *two* clocks on board, and one of those clocks is just enough faster than the other clock so that an extra 80 (or 40) pixels can be displayed on each scan line.

In other words, there's a slow clock (about 25 MHz) that's usually used in graphics modes to get 640 (or 320) pixels on the screen during each scan line, and a second, faster clock (about 28 MHz) that's usually used in text modes to crank out 720 (or 360) pixels per scan line. In particular, 320x400 256-color mode uses the 25-MHz clock.

You can probably see where I'm headed: We can switch from the 25-MHz clock to the 28-MHz clock in 320x480 256-color mode in order to get more pixels. It takes two clocks to produce one 256-color pixel, so we'll get 40 rather than 80 extra pixels by doing this, bringing our horizontal resolution to the desired 360 pixels.

Switching horizontal resolutions sounds easy, doesn't it? It's not. There's no standard VGA mode that uses the 28-MHz clock to draw eight rather than nine dots per character, and so the timing parameters have to be calculated from scratch. John Bridges has already done that for us, but I want you to appreciate that producing this mode took some work. The registers controlling the total number of characters per scan line, the number of characters displayed, the horizontal sync pulse, horizontal blanking, the offset from the start of one line to the start of the next, and the clock speed all have to be altered to set up 360x480 256-color mode. The function **Set360x480Mode** in Listing 1 does all that, as well as setting up the registers that control vertical resolution.

Once that's done, the VGA is in 360x480 mode, awaiting our every high-resolution, 256-color graphics whim.

Accessing Display Memory

Setting up for 360x480 256-color mode proved to be quite a task. Is drawing in this mode going to be as difficult?

No. In fact, if you know how to draw in 320x400 256-color mode, you also know how to draw in 360x480 256-color mode; the conversion between the two is a simple matter of changing the working screen width from 320 pixels to 360 pixels. In fact, if you were to take the 320x400 256-color pixel-reading and -writing code from installment 10

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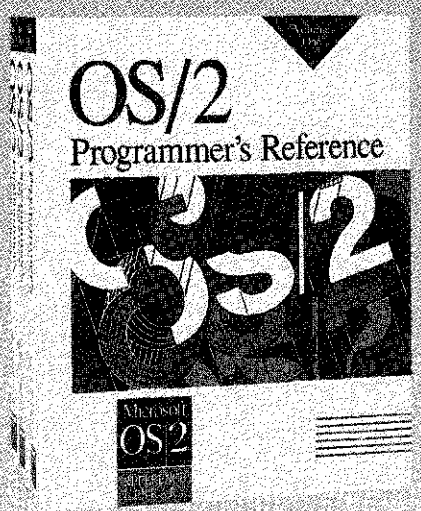

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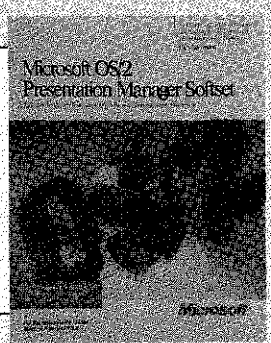

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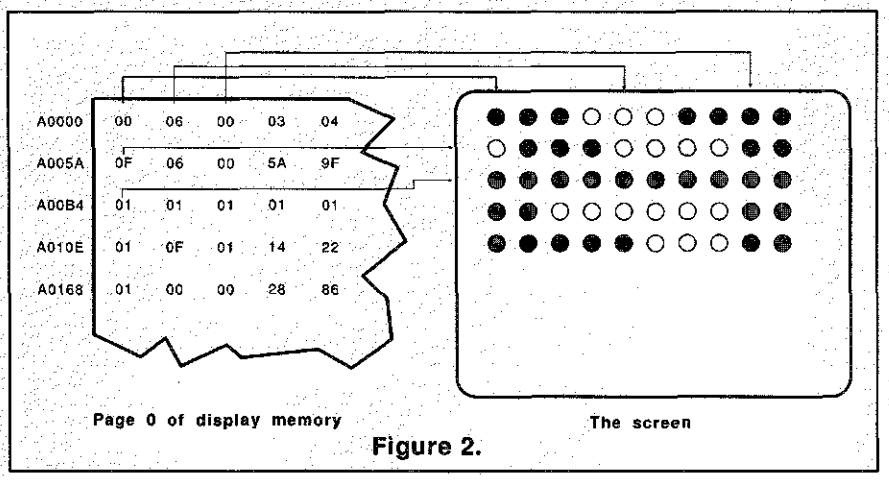

Figure 2.

(*PJ* 7.1) and change the **SCREEN_WIDTH** equate from 320 to 360, those routines would work perfectly in 360x480 256-color mode. (The program as a whole would also have to be changed to use a 360x480 256-color mode set before it would work properly.)

The organization of display memory in 360x480 256-color mode is almost exactly the same as in 320x400 256-color mode (which was covered in detail in installment 10). Each byte of display memory controls one 256-color pixel, just as in mode 13H. The VGA is reprogrammed by the mode set so that adjacent pixels lie in adjacent planes of display memory. Figure 1 (reprinted from installment 10) shows the organization of the first few pixels on the screen; the bytes controlling those pixels run cross-plane, advancing to the next address only every fourth pixel. The address of the pixel at screen coordinate (x,y) is

$$address = [(y * 90) + x] / 4$$

and the plane of a given pixel is

$$plane = x \text{ modulo } 4$$

(Thanks to a reader from Chips & Technologies for pointing out that in installment 10, I mistakenly exchanged x and y in the address and plane equations for 320x400 256-color mode. As he diplomatically pointed out, the equations I gave won't work at all. The correct equations for 320x400 256-color mode are

$$address = [(y * 80) + x] / 4$$
$$plane = x \text{ modulo } 4$$

Fortunately, the code in that installment does implement the correct calculations. I'd gladly thank by name the gentleman from C & T who provided this correction; alas, I've lost his letter. Whoever you are, drop me a line and I'll be most pleased to credit you.)

A new scan line starts every 360 pixels, or 90 bytes, as shown in Figure 2. This is the major programming difference between the 360x480 and 320x400 256-color modes; in the 320x400 mode, a new scan line starts every 80 bytes.

The other programming difference between the two modes is that the area of display memory mapped to the screen is longer in 360x480 256-color mode—which is only common sense, given that there are more pixels in that mode. The exact amount of memory required in 360x480 256-color mode is 360 times 480, or 172,800 bytes. The more perceptive among you will note that that's more than half of the VGA's 256Kb memory complement, which means that page-flipping is out. However, there's no reason you couldn't use that extra memory to create virtual screens larger than 360x480, which you could then scroll around, if you wish. (Horizontal smooth panning is probably not possible, owing to the unusual pixel formatting of this mode. I haven't tried it, however; if any of you out there have tried 360x480 256-color smooth panning, please let me know how it worked.)

That's really all there is to drawing in 360x480 256-color mode. From a programming perspective, this mode is no more complicated than 320x400 256-color mode once the mode set is completed, and it should be capable of good performance given some clever coding. It's not particularly easy to implement bitblt, block-move, or fast line-drawing code for either of the extended 256-color modes, but it can be done—and it's worth the trouble. Even

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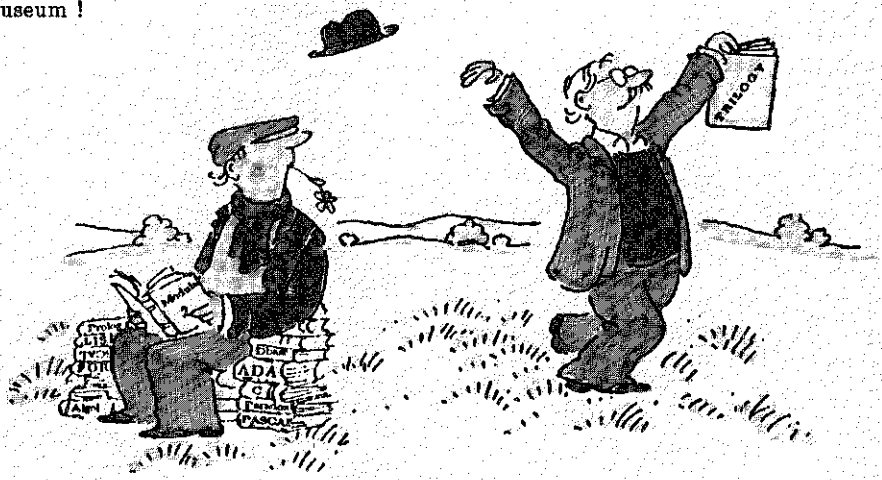

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the small taste we've gotten of the capabilities of these modes shows that they put the traditional CGA, EGA, and (in many cases) even VGA modes to shame.

Measuring Performance

Graphics and performance go hand in hand on the PC. Given the relatively low performance of both the PC and standard PC graphics hardware, high-performance graphics code is a must. In the last installment, I presented a timer for analyzing code performance in detail at a relatively low (close to the hardware) level. That timer is excellent if you want to try to figure out if it's faster to increment a register twice or add 2 to the register, but more-sophisticated tools are needed to identify time-critical code in the context of whole programs and to analyze and improve the performance of algorithms and functions.

Inside! Turbo C (the exclamation point is part of the name), from Paradigm Systems, Inc. (P.O. Box 152, Milford, MA 01757, 508-478-0499, $125.00), is one such performance-analysis tool—and it's a good one. Inside! automatically uses the debugging information Turbo C generates to produce a function-by-function performance profile, which quickly reveals which functions are candidates for optimization. You can then zero in on the truly time-critical code by having Inside! analyze performance at a source-line level or by requesting a performance analysis of one or more specific events.

The best thing about all this is that it doesn't require any particular effort. You don't much need to think about what part of your program to optimize—all you need to do is read over the performance profiles Inside! generates. That, in turn, saves an enormous amount of guesswork, experimentation, and wasted optimization. Basically, Inside! makes it easy to ask the question "Where is my program spending its time?" Once you start asking that question, it's astonishing how often you'll find that it's possible to eliminate huge chunks of execution time.

Inside! is oriented toward use with C rather than assembly language programs. You can analyze assembly language code with Inside! (although a bug in TASM 1.0, which should by fixed in TASM 1.1, makes MASM a better choice right now), but that's more easily done with assembly language code that's part of a C program than with stand-alone assembly language. I *was* able to analyze stand-alone assembly language, but the manual doesn't provide much information, and it took me a good bit of fiddling around to get things working. (By the way, Inside!'s results matched those from the timer I presented in the last installment; however, because Inside! leaves interrupts enabled, it is both somewhat less accurate for short timing intervals and capable of timing much longer intervals.) Still, few substantial programs are written entirely in assembly language (who has the time to waste writing initialization code and the like in assembly language?), and those sizable C–assembly language hybrid programs are exactly the sort of programs for which the ability of Inside! to produce easily interpreted performance statistics is most useful.

Inside! is easy to use and reliable. Paradigm has encountered and dealt with some hairy performance-analysis problems that I wouldn't have cared to figure out for myself, such as running

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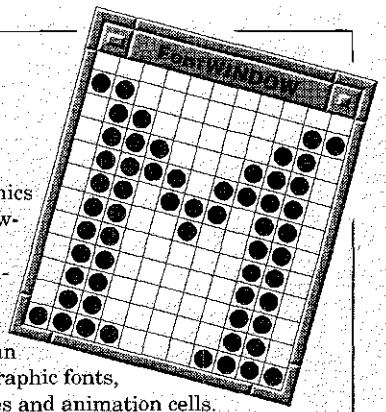

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in virtual-8086 environments, which intercept interrupts in sometimes unpredictable ways. Inside! is not quite perfect, however. For one thing, the manual (like most) could use some work: There's no index, and the examples could be explained in considerably more detail. On the other hand, there's a tremendous amount of useful technical information packed into less than 100 pages, if you're willing to work a bit to understand it.

The only other problem I encountered with Inside! is that it doesn't handle very large programs. Understand that I mean *very* large programs: The program I couldn't analyze with Inside! requires a minimum of 540Kb free to run. I don't know of anything else that can analyze this program, either, so that probably isn't a fair criticism. That program is one I co-wrote, however, and I very much wanted to use Inside! on it, but the two packages just couldn't fit into memory together. At any rate, the people at Paradigm have workarounds for analyzing all but the most severely memory-constrained programs and are working on using overlays, expanded memory, and the like to eliminate the problem in the next release.

All in all, Inside! Turbo C is a must-have tool for C programmers concerned with performance. That's particularly true because Inside! makes it so easy for programmers to raise their optimization sights from individual statements and instructions to the algorithm–function level, where the greatest potential savings often await, and to identify efficiently code that's worth optimizing.

Versions of Inside! for Microsoft C, Turbo Pascal, and other compilers are also available.

In Conclusion

For now, we've come to the end of the 256-color rainbow. So far as I know, there aren't any more 256-color modes hiding in the standard IBM VGA. Of course, there are several *SuperVGA* 256-color modes around, and the 8514/A—with a 1024x768 256-color mode—is coming on strong. (Look for hardware-compatible clones of the 8514/A soon; when those become widely available and prices drop, the move to the next PC-graphics standard may well begin in earnest.) If there's enough reader interest in either SuperVGA modes or the 8514/A, I'll cover them; for now, though, I'll keep on keeping on with the VGA. Next time, I'll look into the potent combination of the VGA's split-screen and panning features, and in the not-too-distant future, I'll move on to drawing circles, ellipses, and the like . . . and drawing them fast, as always.

See you next time. PJ

Michael Abrash is a senior software engineer for Orion Instruments, Inc., in Redwood City, California, and a contributing editor of Programmer's Journal. Power Graphics Programming, *an anthology of Michael's "On Graphics" articles published by Que Corporation and* PJ, *is now available in bookstores and by mail order. Michael is also the author of* The Zen of Assembler, *due out this fall from Scott, Foresman & Company. Readers may write to Michael at 1599 Bittern Drive, Sunnyvale, CA 94087, or contact him via MCI Mail, username* MABRASH.

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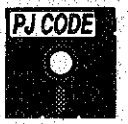

All code in this issue is available on 360K, MS-DOS disks.
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Mail-order information on pages 8 and 88.

Code from "Still-Higher . . . Resolutions," by Michael Abrash

1

LISTING 1

```
;
; Turbo C tiny/small/medium model-callable assembler
; subroutines to:
;       * Set 360x480 256-color VGA mode
;       * Draw a dot in 360x480 256-color VGA mode
;       * Read the color of a dot in 360x480 256-color VGA mode
;
; Assembled with TASM 1.0.
;
; The 360x480 256-color mode set code and parameters were provided
; by John Bridges, who has placed them into the public domain.
;
VGA_SEGMENT     equ     0a000h  ;display memory segment
SC_INDEX        equ     3c4h    ;Sequence Controller Index register
GC_INDEX        equ     3ceh    ;Graphics Controller Index register
MAP_MASK        equ     2       ;Map Mask register index in SC
READ_MAP        equ     4       ;Read Map register index in GC
SCREEN_WIDTH    equ     360     ;# of pixels across screen
WORD_OUTS_OK    equ     1       ;set to 0 to assemble for
                                ; computers that can't handle
                                ; word outs to indexed VGA registers
;
_DATA   segment public byte 'DATA'
;
; 360x480 256-color mode CRT Controller register settings.
; (Courtesy of John Bridges.)
;
vptbl   dw      06b00h  ; horz total
        dw      05901h  ; horz displayed
        dw      05a02h  ; start horz blanking
        dw      08e03h  ; end horz blanking
        dw      05e04h  ; start h sync
        dw      08a05h  ; end h sync
        dw      00d06h  ; vertical total
        dw      03e07h  ; overflow
        dw      04009h  ; cell height
        dw      0ea10h  ; v sync start
        dw      0ac11h  ; v sync end and protect cr0-cr7
        dw      0df12h  ; vertical displayed
        dw      02d13h  ; offset
        dw      00014h  ; turn off dword mode
        dw      0e715h  ; v blank start
        dw      00616h  ; v blank end
        dw      0e317h  ; turn on byte mode
vpend   label   word
_DATA   ends
;
; Macro to output a word value to a port.
;
OUT_WORD        macro
if WORD_OUTS_OK
        out     dx,ax
else
        out     dx,al
        inc     dx
        xchg    ah,al
        out     dx,al
        dec     dx
        xchg    ah,al
endif
        endm
;
_TEXT   segment byte public 'CODE'
        assume  cs:_TEXT, ds:_DATA
;
; Sets up 360x480 256-color mode.
```

2

```
; (Courtesy of John Bridges.)
;
; Call as: void Set360By480Mode()
;
; Returns: nothing
;
        public _Set360x480Mode
_Set360x480Mode proc    near
        push    si              ;preserve C register vars
        push    di
        mov     ax,12h          ; start with mode 12h
        int     10h             ; let the bios clear the video memory

        mov     ax,13h          ; start with standard mode 13h
        int     10h             ; let the bios set the mode

        mov     dx,3c4h         ; alter sequencer registers
        mov     ax,0604h        ; disable chain 4
        out     dx,ax

        mov     ax,0100h        ; synchronous reset
        out     dx,ax           ; asserted
        mov     dx,3c2h         ; misc output
        mov     al,0e7h         ; use 28 mHz dot clock
        out     dx,al           ; select it
        mov     dx,3c4h         ; sequencer again
        mov     ax,0300h        ; restart sequencer
        out     dx,ax           ; running again

        mov     dx,3d4h         ; alter crtc registers

        mov     al,11h          ; cr11
        out     dx,al           ; current value
        inc     dx              ; point to data
        in      al,dx           ; get cr11 value
        and     al,7fh          ; remove cr0 -> cr7
        out     dx,al           ;    write protect
        dec     dx              ; point to index
        cld
        mov     si,offset vptbl
        mov     cx,((offset vpend)-(offset vptbl)) shr 1
@b:     lodsw
        out     dx,ax
        loop    @b
        pop     di          ;restore C register vars
        pop     si
        ret
_Set360x480Mode endp
;
; Draws a pixel in the specified color at the specified
; location in 360x480 256-color mode.
;
; Call as: void Draw360x480Dot(int X, int Y, int Color)
;
; Returns: nothing
;
DParms  struc
        dw      ?       ;pushed BP
        dw      ?       ;return address
DrawX   dw      ?       ;X coordinate at which to draw
DrawY   dw      ?       ;Y coordinate at which to draw
Color   dw      ?       ;color in which to draw (in the
                        ; range 0-255; upper byte ignored)
DParms  ends
;
        public _Draw360x480Dot
_Draw360x480Dot proc    near
        push    bp      ;preserve caller's BP
        mov     bp,sp   ;point to stack frame
        push    si      ;preserve C register vars
        push    di
        mov     ax,VGA_SEGMENT
        mov     es,ax   ;point to display memory
        mov     ax,SCREEN_WIDTH/4
```

Code continues . . .

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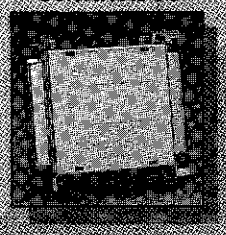

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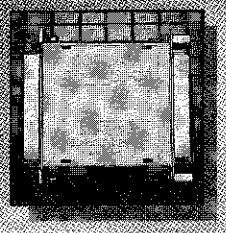

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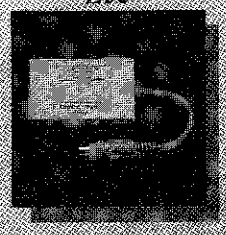

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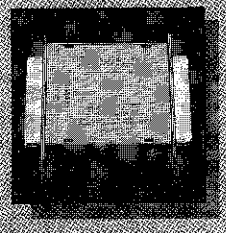

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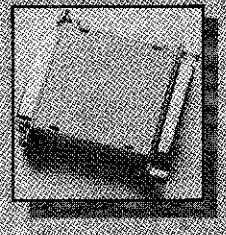

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Abrash code, continued

3

```
                        ;there are 4 pixels at each address, so
                        ; each 360-pixel row is 90 bytes wide
                        ; in each plane
        mul     [bp+DrawY] ;point to start of desired row
        mov     di,[bp+DrawX] ;get the X coordinate
        shr     di,1    ;there are 4 pixels at each address
        shr     di,1    ; so divide the X coordinate by 4
        add     di,ax   ;point to the pixel's address
        mov     cl,byte ptr [bp+DrawX] ;get the X coordinate again
        and     cl,3    ;get the plane # of the pixel
        mov     ah,1
        shl     ah,cl   ;set the bit corresponding to the plane
                        ; the pixel is in
        mov     al,MAP_MASK
        mov     dx,SC_INDEX
        OUT_WORD        ;set to write to the proper plane for
                        ; the pixel
        mov     al,byte ptr [bp+Color]  ;get the color
        stosb           ;draw the pixel
        pop     di      ;restore C register vars
        pop     si
        pop     bp      ;restore caller's BP
        ret
_Draw360x480Dot endp
;
; Reads the color of the pixel at the specified
; location in 360x480 256-color mode.
;
; Call as: int Read360x480Dot(int X, int Y)
;
; Returns: pixel color
;
RParms  struc
        dw      ?       ;pushed BP
        dw      ?       ;return address
ReadX   dw      ?       ;X coordinate from which to read
ReadY   dw      ?       ;Y coordinate from which to read
RParms  ends
;
        public _Read360x480Dot
_Read360x480Dot proc    near
        push    bp      ;preserve caller's BP
        mov     bp,sp   ;point to stack frame
        push    si      ;preserve C register vars
        push    di
        mov     ax,VGA_SEGMENT
        mov     es,ax   ;point to display memory
        mov     ax,SCREEN_WIDTH/4
                        ;there are 4 pixels at each address, so
                        ; each 360-pixel row is 90 bytes wide
                        ; in each plane
        mul     [bp+DrawY] ;point to start of desired row
        mov     si,[bp+DrawX] ;get the X coordinate
        shr     si,1    ;there are 4 pixels at each address
        shr     si,1    ; so divide the X coordinate by 4
        add     si,ax   ;point to the pixel's address
        mov     ah,byte ptr [bp+DrawX]
                        ;get the X coordinate again
        and     ah,3    ;get the plane # of the pixel
        mov     al,READ_MAP
        mov     dx,GC_INDEX
        OUT_WORD        ;set to read from the proper plane for
                        ; the pixel
        lods    byte ptr es:[si] ;read the pixel
        sub     ah,ah   ;make the return value a word for C
        pop     di      ;restore C register vars
        pop     si
        pop     bp      ;restore caller's BP
        ret
_Read360x480Dot endp
_TEXT   ends
        end
```

4

LISTING 2

```
/*
 * Sample program to illustrate VGA line drawing in 360x480
 * 256-color mode.
 *
 * Compiled with Turbo C 2.0.
 *
 * Must be linked with Listing 1 with a command line like:
 *
 *    tcc l2 l1.asm
 *
 * By Michael Abrash.  6/2/89.
 */
#include <dos.h>                /* contains geninterrupt */

#define TEXT_MODE       0x03
#define BIOS_VIDEO_INT  0x10
#define X_MAX           360     /* working screen width */
#define Y_MAX           480     /* working screen height */

extern void Draw360x480Dot();
extern void Set360x480Mode();

/*
 * Draws a line in octant 0 or 3 ( |DeltaX| >= DeltaY ).
 * |DeltaX|+1 points are drawn.
 */
void Octant0(X0, Y0, DeltaX, DeltaY, XDirection, Color)
unsigned int X0, Y0;            /* coordinates of start of the line */
unsigned int DeltaX, DeltaY;    /* length of the line */
int XDirection;                 /* 1 if line is drawn left to right,
                                   -1 if drawn right to left */
int Color;                      /* color in which to draw line */
{
   int DeltaYx2;
   int DeltaYx2MinusDeltaXx2;
   int ErrorTerm;

   /* Set up initial error term and values used inside drawing loop */
   DeltaYx2 = DeltaY * 2;
   DeltaYx2MinusDeltaXx2 = DeltaYx2 - (int) ( DeltaX * 2 );
   ErrorTerm = DeltaYx2 - (int) DeltaX;

   /* Draw the line */
   Draw360x480Dot(X0, Y0, Color);   /* draw the first pixel */
   while ( DeltaX-- ) {
        /* See if it's time to advance the Y coordinate */
        if ( ErrorTerm >= 0 ) {
           /* Advance the Y coordinate & adjust the error term
              back down */
           Y0++;
           ErrorTerm += DeltaYx2MinusDeltaXx2;
        } else {
           /* Add to the error term */
           ErrorTerm += DeltaYx2;
        }
        X0 += XDirection;           /* advance the X coordinate */
        Draw360x480Dot(X0, Y0, Color);    /* draw a pixel */
   }
}

/*
 * Draws a line in octant 1 or 2 ( |DeltaX| < DeltaY ).
 * |DeltaY|+1 points are drawn.
 */
void Octant1(X0, Y0, DeltaX, DeltaY, XDirection, Color)
unsigned int X0, Y0;            /* coordinates of start of the line */
unsigned int DeltaX, DeltaY;    /* length of the line */
int XDirection;                 /* 1 if line is drawn left to right,
                                   -1 if drawn right to left */
int Color;                      /* color in which to draw line */
{
   int DeltaXx2;
```

Code continues . . .

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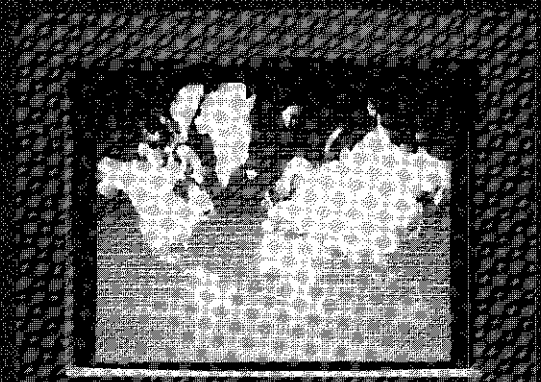

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Abrash code, continued

5

```
   int DeltaXx2MinusDeltaYx2;
   int ErrorTerm;

   /* Set up initial error term and values used inside drawing loop */
   DeltaXx2 = DeltaX * 2;
   DeltaXx2MinusDeltaYx2 = DeltaXx2 - (int) ( DeltaY * 2 );
   ErrorTerm = DeltaXx2 - (int) DeltaY;

   Draw360x480Dot(X0, Y0, Color);     /* draw the first pixel */
   while ( DeltaY-- ) {
      /* See if it's time to advance the X coordinate */
      if ( ErrorTerm >= 0 ) {
         /* Advance the X coordinate & adjust the error term
            back down */
         X0 += XDirection;
         ErrorTerm += DeltaXx2MinusDeltaYx2;
      } else {
         /* Add to the error term */
         ErrorTerm += DeltaXx2;
      }
      Y0++;                  /* advance the Y coordinate */
      Draw360x480Dot(X0, Y0,Color);  /* draw a pixel */
   }
}

/*
 * Draws a line on the EGA or VGA.
 */
void EVGALine(X0, Y0, X1, Y1, Color)
int X0, Y0;     /* coordinates of one end of the line */
int X1, Y1;     /* coordinates of the other end of the line */
unsigned char Color;     /* color in which to draw line */
{
   int DeltaX, DeltaY;
   int Temp;

   /* Save half the line-drawing cases by swapping Y0 with Y1
      and X0 with X1 if Y0 is greater than Y1. As a result, DeltaY
      is always > 0, and only the octant 0-3 cases need to be
      handled. */
   if ( Y0 > Y1 ) {
      Temp = Y0;
      Y0 = Y1;
      Y1 = Temp;
      Temp = X0;
      X0 = X1;
      X1 = Temp;
   }

   /* Handle as four separate cases, for the four octants in which
      Y1 is greater than Y0 */
   DeltaX = X1 - X0;     /* calculate the length of the line
                            in each coordinate */
   DeltaY = Y1 - Y0;
   if ( DeltaX > 0 ) {
      if ( DeltaX > DeltaY ) {
         Octant0(X0, Y0, DeltaX, DeltaY, 1, Color);
      } else {
         Octant1(X0, Y0, DeltaX, DeltaY, 1, Color);
      }
   } else {
      DeltaX = -DeltaX;              /* absolute value of DeltaX */
      if ( DeltaX > DeltaY ) {
         Octant0(X0, Y0, DeltaX, DeltaY, -1, Color);
      } else {
         Octant1(X0, Y0, DeltaX, DeltaY, -1, Color);
      }
   }
}

/*
 * Subroutine to draw a rectangle full of vectors, of the
 * specified length and in varying colors, around the
 * specified rectangle center.
```

6

```
 */
void VectorsUp(XCenter, YCenter, XLength, YLength)
int XCenter, YCenter;   /* center of rectangle to fill */
int XLength, YLength;   /* distance from center to edge
                           of rectangle */
{
   int WorkingX, WorkingY, Color = 1;

   /* Lines from center to top of rectangle */
   WorkingX = XCenter - XLength;
   WorkingY = YCenter - YLength;
   for ( ; WorkingX < ( XCenter + XLength ); WorkingX++ )
      EVGALine(XCenter, YCenter, WorkingX, WorkingY, Color++);

   /* Lines from center to right of rectangle */
   WorkingX = XCenter + XLength - 1;
   WorkingY = YCenter - YLength;
   for ( ; WorkingY < ( YCenter + YLength ); WorkingY++ )
      EVGALine(XCenter, YCenter, WorkingX, WorkingY, Color++);

   /* Lines from center to bottom of rectangle */
   WorkingX = XCenter + XLength - 1;
   WorkingY = YCenter + YLength - 1;
   for ( ; WorkingX >= ( XCenter - XLength ); WorkingX-- )
      EVGALine(XCenter, YCenter, WorkingX, WorkingY, Color++);

   /* Lines from center to left of rectangle */
   WorkingX = XCenter - XLength;
   WorkingY = YCenter + YLength - 1;
   for ( ; WorkingY >= ( YCenter - YLength ); WorkingY-- )
      EVGALine(XCenter, YCenter, WorkingX, WorkingY, Color++);
}

/*
 * Sample program to draw four rectangles full of lines.
 */
int main()
{
   char temp;

   Set360x480Mode();

   /* Draw each of four rectangles full of vectors */
   VectorsUp(X_MAX / 4, Y_MAX / 4, X_MAX / 4, Y_MAX / 4, 1);
   VectorsUp(X_MAX * 3 / 4, Y_MAX / 4, X_MAX / 4, Y_MAX / 4, 2);
   VectorsUp(X_MAX / 4, Y_MAX * 3 / 4, X_MAX / 4, Y_MAX / 4, 3);
   VectorsUp(X_MAX * 3 / 4, Y_MAX * 3 / 4, X_MAX / 4, Y_MAX / 4, 4);

   /* Wait for the enter key to be pressed */
   scanf("%c", &temp);

   /* Back to text mode */
   _AX = TEXT_MODE;
   geninterrupt(BIOS_VIDEO_INT);
}
```


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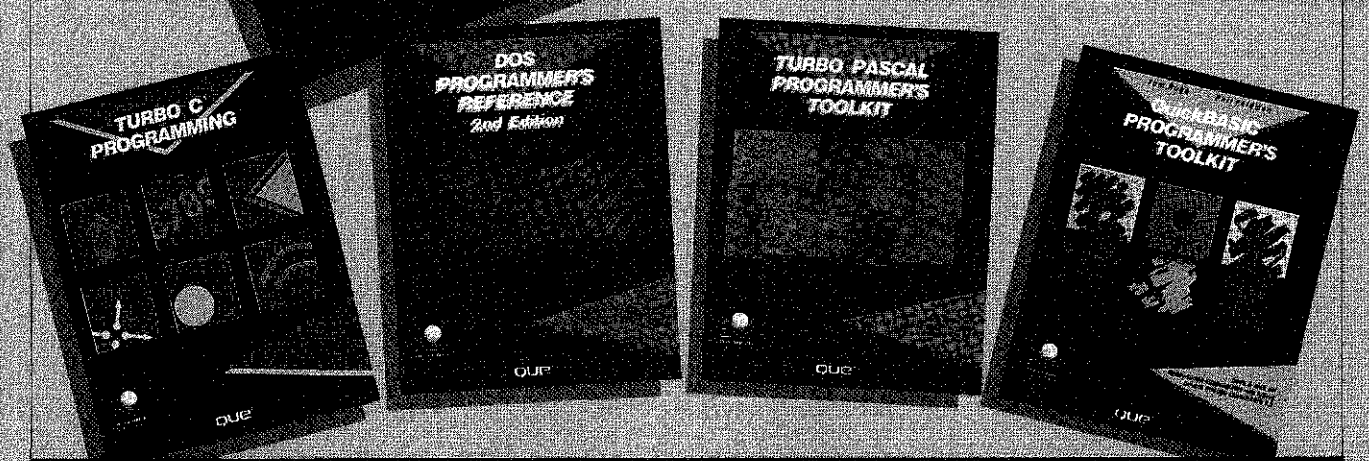

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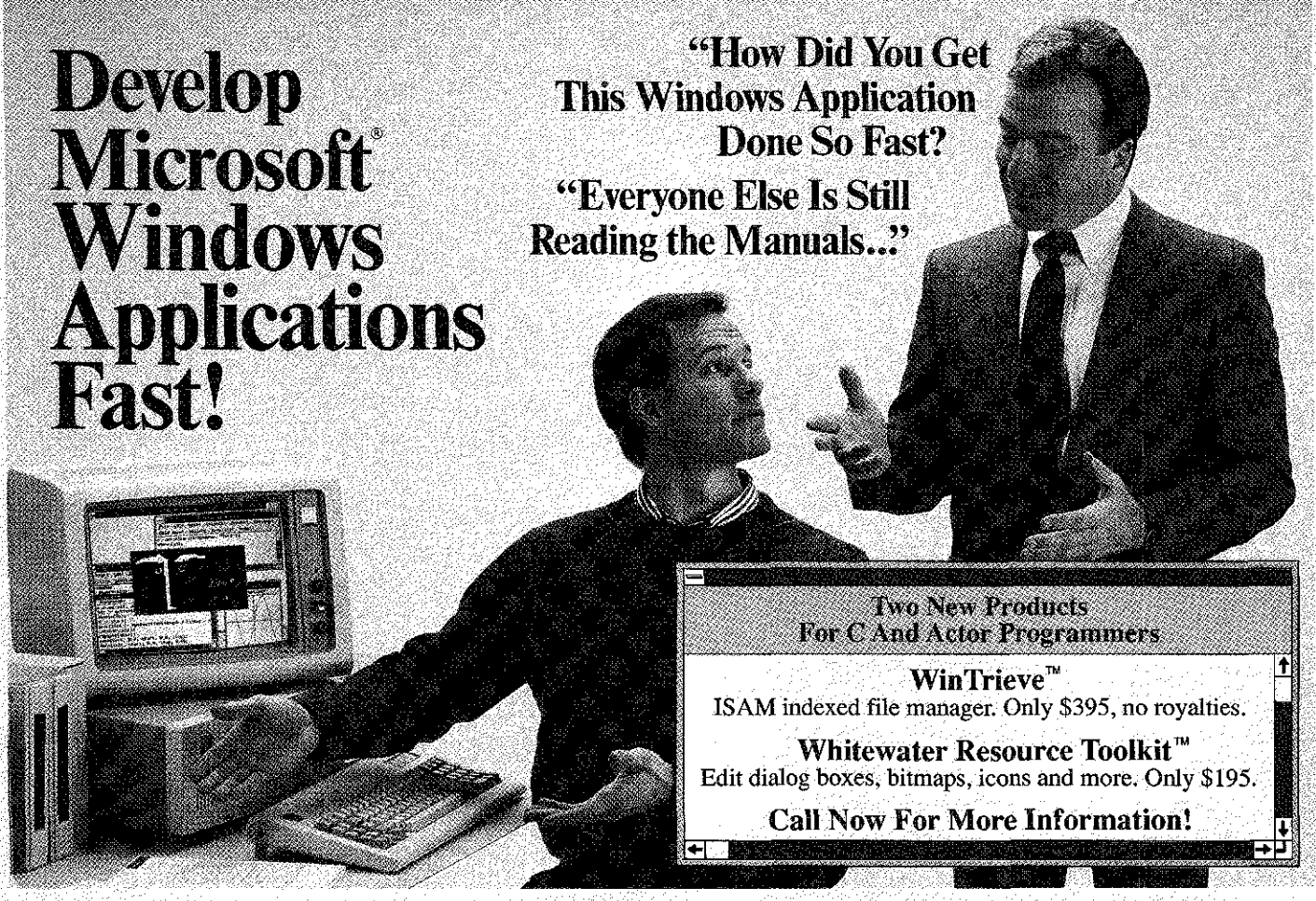
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The Forest for the Trees

by

Vaughn Vernon

While I have concentrated on writing code in the past, this article will focus more on an issue that will affect your C++ development: the style of class libraries you purchase and develop. Although you may not realize it, C++ allows you to use and develop software in several different styles. In fact, you can even use C++ as a non-object-oriented language. Nevertheless, I will continue to discuss how C++ fits into object-oriented programming and also describe two different approaches to class libraries.

The Issues

A very big issue in object-oriented programming is cooperation—how does one object live with and relate to another to accomplish the ultimate goal? Can objects of various classes coexist and share resources without problems?

Exception handling is another extremely important issue. In C++, exceptions can occur with all the dynamic "new" memory being allocated and freed on the fly. If you came into a function expecting to declare and use a particular object, but no memory existed to allocate the object, a program without exception handling would continue to ramble on until core dumped or the machine locked up. However, with a robust exception-handling mechanism, you would be more likely to recover from the error and exit elegantly.

The last, but definitely not least, issue is ease of use. Whether or not a class library is easy to use will determine its ultimate success or failure. Ease of use is quite possibly more important than the other two issues.

Existing Work

If you have used C++ at all, you know that C++ class libraries are not widely available to mere mortals. I have talked to several folks from AT&T Bell Labs who relate the joy of using this-class or that-class library, but I have yet to see one packaged with C++. There are some public domain offerings, but, as you well know with public domain, "what you seize is what you gets()!" So, in order to discuss the theories behind the development and use of class libraries, I may at times have to refer to offerings from other OO languages.

One of the public domain offerings is the OOPS library from Keith Gorlen of the National Institutes of Health. This set of C++ classes offers a Smalltalk-like library. Smalltalk provides a class-rich programming environment that includes facilities for managing anything from bit vectors to windows. But for our discussion, I want to focus on *how* Smalltalk and, hence, the OOPS library implement its classes.

The Smalltalk approach to classes is via a class-hierarchy tree. (Many other popular OO systems, such as Eiffel, C_Talk, and Objective-C, use the Smalltalk approach.) At the class-tree root is the class Object. The tree grows from the root as new classes inherit from Object. As a result, all new classes inherit from Object no matter how far from the root they live. A partial class tree is shown in Figure 1.

In Smalltalk, when a new class is needed, and that class is truly unique and does not need to inherit from higher-level classes, it must at least inherit from Object. So, Blip would be derived from Object in the OOPS library:

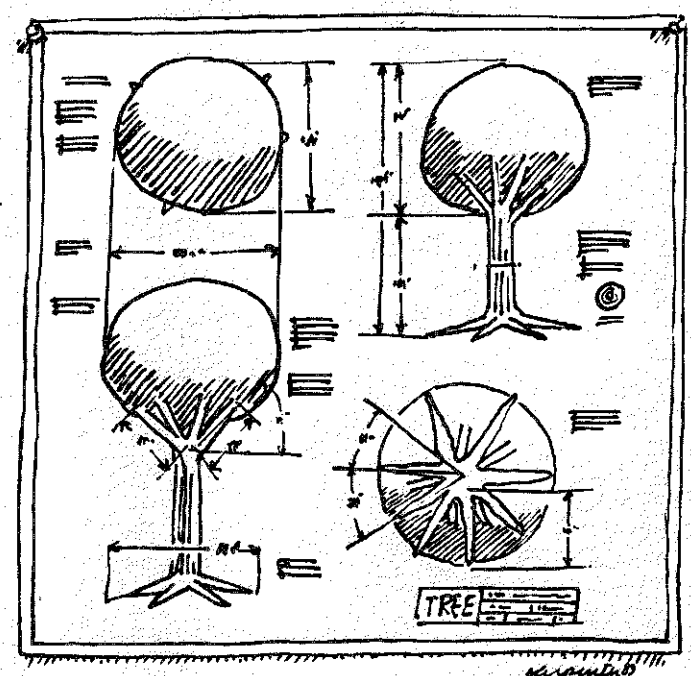
```
class Blip : public Object { // ... };
```

By inheriting from Object, the class is given features that are necessary for life in the Smalltalk (and, hence, the OOPS library) environment. You will see why a little later.

On the other hand, most class libraries that I have seen or read about for the PC (and other) implementations of C++ have taken on a form different from the Smalltalk approach. These class libraries do not promote a tree structure of classes that grow from a root class. When a new class is needed that is unique and does not *require* features from an existing class, the class is created as a new root of its own:

```
class Blip { // ... };
```

If another class needs the features of the Blip class, it inherits from Blip, which continues the growth of the new tree. Since



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so many of these trees are usually found in a class library, it is appropriate to refer to a "forest" of C++ classes (see Figure 2).

I cannot take credit for coining the forest description. I'm not sure who thought of it first, but I first heard the term at the 1988 Usenix C++ Conference in Denver, where it was used by Douglas Lea to describe the structure (or lack thereof) in the libg++ class library. (The libg++ project was sponsored by Project GNU.) In his paper, Mr. Lea described his forest approach as a "less ambitious-looking approach."

A Tree or a Forest; A ++ or -- ?

Is there a definite advantage to using a tree approach or a forest approach? The answer may be yes or no. It really depends on what you want to accomplish and what you expect out of your class library. Let's consider some advantages and disadvantages of both approaches.

First off, if you examine the very nature of the tree approach, you get an idea of the advantages available. Since all classes have a common ancestor, Object, all classes *are* objects. That means that all objects of any class can be created, collected, compared and generally manipulated as objects, and each object knows its real class. You automatically inherit class methods that operate on generic objects. Also, new class methods can be written in a generic way by taking arguments of type Object, Object *, or Object &, since *most* arguments are Objects. All that means code reuse.

For instance, say you wish to create a Collection class. A Collection is basically an array of arbitrary objects. However, since all elements of the Collection are ultimately Objects, the Collection class requires no special-case code to deal with special-case classes. Additionally, if you added the class method, you could ask a generic object to print its class tree, and it could show you the path all the way back to Object!

Similarly, since all classes inherit from Object, implementing an exception-handler mechanism for all classes is easy. You would place the exception-handler protocol in the Object class, and all new classes would inherit the feature. William Miller of Software Development Technologies, Inc., contributed a nice solution.

Now for the bad news: Unfortunately, not everything in C++ (as of v1.2) is an Object. Take the standard C data types—**int**, **char**, **float**, **long**, and so forth. If you want a Collection of **int** variables, you're up a creek. And if you plan on supporting your own Integer, Float, or Character classes, have fun—I'm sure that such an effort would lead to performance pains and other eventual headaches. This is a problem that should be solved by the proposed C++ v2.0 parameterized types.

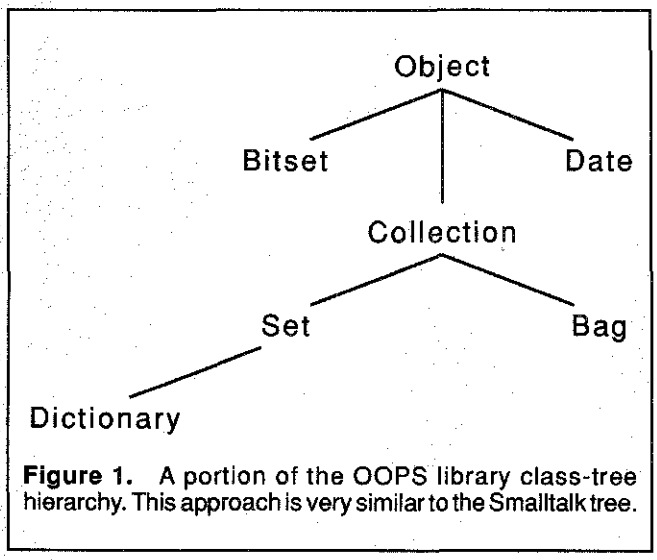

Figure 1. A portion of the OOPS library class-tree hierarchy. This approach is very similar to the Smalltalk tree.

Additionally, those whom I have spoken to about the OOPS library have found it hard to use. They claim that when you want to derive a new class, there are "so many virtual methods" that reimplementing them for each new class is a job in itself. It takes some time before you start solving the problem you set out to solve. This is not necessarily a reflection on Gorlen's work but, rather, a reflection on what he had to do to tip-toe (or possibly stomp) around things that the current version of C++ was never designed to handle. However, I imagine that the problem could be solved with a few compromises yielding a lot more simplicity and, therefore, ease of use.

One parting thought on the OOPS library: It was developed on UNIX with obvious lack of regard for DOS limitations; it was never meant to be portable. I have a copy of it in DOS format, but things like long filenames and the overall size and complexity of the library make it difficult to impossible to use under DOS. I'm sure no translator could survive its demands for memory, and the Zortech compiler would not handle its syntax. This really has nothing to do with a class-tree problem, but it may save you from rushing out to get a copy of it.

As you will see, the forest approach has its own advantages and disadvantages. Oddly enough, the advantages of one approach seem to highlight the disadvantages of the other, and vice versa. Since a forest library inherits only when necessary, you don't end up reimplementing virtual methods defined in class Object for each and every class. This tends to make problem solving straightforward and as fast as possible.

However, the Collection class discussed earlier cannot be written as elegantly using the forest method. You must use an alternative, kludged approach, since no one object can be guaranteed to be related to any other. I do not have the space for details here, but you can find a discussion of it in the Stroustrup book (see references) on page 209, under the heading "Generic Classes." This method also lacks a high degree of code reuse.

The forest approach is also lacking in its ability to couple well with the exception-handling mechanism mentioned earlier. That is because you are not forced to inherit from a single common class, which would contain the exception-handling protocol.

All in all, the forest approach seems to be the easiest to use, at least for beginners. It has the approval of many in the C++ community. However, you sure pass up a lot by overlooking the tree approach. To me, at least, this would be the ultimate approach if some needed features where added to C++.

Which Approach Is Better for You?

It depends on what you want to accomplish. If exception handling is a must, then the tree approach fits your needs better, at least at this stage of C++ infancy. However, the forest approach is good for adding a veneer over an existing C library. For instance, if you were to create a C++ class interface to an existing tool such as a database library, wrapping the func-

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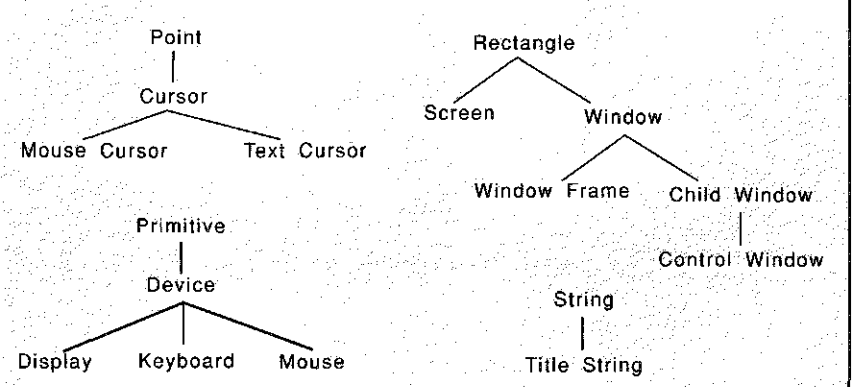

Figure 2. A possible windowing library using the "forest" approach. Classes are created as needed, without regard for structure.

It is obvious to me that C++ needs a standard class library, just as C needed a standard C library, and it should be defined by the language implementors (let's not give it to ANSI just yet). It does not need to be very elaborate—just the basics: Collection, Stack, Date, Time, InputFile, OutputFile, and the like, probably the same basic classes the OOPS library contains, but easier to use, small, and portable. In addition, the exception-handling protocol would be part of the Object class. This would at least give those who are developing specialty class libraries a basis with which to start, and it wouldn't limit you from adding multiple inheritance to the branches of the tree.

tion interface with a set of classes and in-line methods would be fast and easy using the forest approach.

If you attempted to use a tree and a forest library at the same time, they would not cooperate well with one another. Clearly, if you commit to either of these approaches, it could lock you out from using future tools. For instance, what if AT&T chooses to bundle a "Standard C++ Class Library" with the translator starting in version 2.0? If their library were a tree type, and you committed to a forest approach now, using a standard library later could be tough—a problem that probably prevents most companies from switching from C to C++ right now.

Cfront: Out of Memory

In my last article (*PJ* 7.3), I talked about the problems most DOS-based C++ translators have with memory. I would like to get something straight here: When I criticize a memory problem, I am not criticizing the people who ported a program to DOS. Although some want to argue over details, others are willing to listen to solutions. Nevertheless, it is a problem. To deny it would be an injustice to my readers. Cfront, the C++ translator, is a huge program, and besides, it does a lot of memory allocation on top of that! To translate even the seemingly simplest source can be a nightmare. And running MAKE to build your program is out of the question.

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If you have a shortage of memory, I have two solutions for you:

- Buy an 80386 AT-compatible and put a least 2 megabytes of memory in it. Then do one of the following: Buy the C++ translator or add-on translator with a 386 DOS extender to take advantage of extended memory, or buy 386 UNIX and VP/IX or a UNIX cross-translator that creates DOS binaries. This will cost you about $4,000—maybe less if you shop around.
- Try out the MAKE program that I've included on this issue's code disk.

Although I just said you couldn't use MAKE to build your .EXE, I also forgot to tell you about my simple MAKE program. About five years ago, when I first began to fiddle around with my CURSES Window library, all I had to develop on was a 8086 PC with 256K of memory. I wrote a MAKE program because no one else had one, and I couldn't stand manual labor. Then I noticed that some programs were too large for MAKE to spawn. So I added a cute little feature: a command line switch to cause MAKE to generate a DOS batch file (.BAT) rather than try to run the commands directly. So after typing MAKE (about two seconds later), I just typed **mk** to run the batch file.

Well, CURSES started to sell, and I bought myself an AT and put 3.2 megabytes of memory in it (for OS/2). I no longer had a 256K limit. But, soon enough, I discovered that I now had a 640K limit when using C++. Back to the drawing board! I recently modified my MAKE to support the various C++ translators I own. Although you may still find memory limited, at least you can use MAKE again.

If you are into trying a C++ for 386 DOS extended memory, this translator may be for you. A company called Intek (Integration Technologies, 1400 112th Street S.E., Suite 202, Bellevue, WA 98004, 206-455-9935) uses C++ to develop custom software. They recently made available (for $495.00) an extended memory version for 386 machines. A big difference between the Intek offering and several of the others is that Intek supports other compilers in addition to Microsoft C— Turbo C and WATCOM for MS-DOS applications and MetaWare High C for 386-specific applications. PJ

Vaughn Vernon is president of Aspen Scientific, producers of CURSES and FORMATION, user-interface cross-development tools for UNIX, MS-DOS, OS/2, and VMS. He can be reached at P.O. Box 72, Wheatridge, CO 80034.

References

Gorlen, Keith E., "An Object-Oriented Class Library for C++ Programs," USENIX Proceedings, C++ Workshop, 1987.

Lea, Douglas, "libg++, The GNU C++ Library," Usenix Proceedings, C++ Workshop, 1988.

Miller, William M., "Exception Handling Without Language Extensions," Usenix Proceedings, C++ Workshop, 1988.

Stroustrup, Bjorne, *The C++ Programming Language*, Addison-Wesley, 1986.

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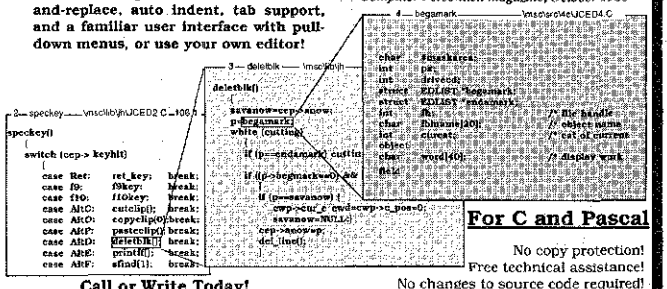

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From C to Objects

by

Steve Sando

Maybe you're different, but I struggled to understand object-oriented programming (OOP). Most of the explanations involved things like car trunks and mailboxes. I have trouble accepting things when I don't know how they work. OOP was no different. But once I understood the mechanics, I saw the value in OOP and how to apply it.

In this article, we'll use some real programming examples to bridge the gap between traditional and object-oriented programming. We'll look at some programming problems whose solutions are quite close to the object-oriented method. Then we'll take the same problem set and convert it from straight C to an OOP extension for C, called SCC (see sidebar). By first pushing C as close as possible to OOP, the transition should be made simpler.

This article will also introduce the basics of the OOP vocabulary by applying OOP names to such standard C elements as structures and functions. Once you have a familiar frame of reference for concepts like "inheritance," you will be better prepared to make use of them.

The programming examples are familiar to all professional programmers. They are common problems involved with making reusable code, and they demonstrate the higher level of reusability achieved with object-oriented programming.

So, let's solve a problem using only traditional C programming techniques. We will solve it as best we can. There will be problems, seemingly unavoidable, when we are finished—problems that cause maintenance headaches and inelegant solutions.

OOP-Style Programming in Straight C—Roughly

Here's the problem: You have been assigned to convert some arrays of structures into two-way linked lists. The first step, of course, is to add a pair of pointers to the structures; **prev** to point to the previous item, and **next** to point to the next item. Then, you need to produce functions for adding and deleting members and printing the list. This is all fine for a linked list of only one type, but there are *many* types. In fact, the boss wants to be able to add new data types and still reuse your code. How do you avoid repeating the functions for each type of structure?

One way is to place the **prev** and **next** pointers in a fixed place in all the different structures. This way, the linked-list functions would not need to be concerned with the type of structure and would work only with the two pointers they know about.

Does this answer make you nervous? It means you have to pass different types of structures to the same function! Examples will demonstrate how this can be done. They assure the location of the **prev** and **next** pointers by embedding a special structure at the beginning of each data structure.

Take a close look at the examples. COOP.H (Listing 2) defines a set of structures that make use of a special structure called TWLL. COOP.C (Listing 3) has functions that assume they receive a pointer to TWLL. There are also specialized functions for each type of structure. To differentiate between the structure types, there is a type field. This allows the general-purpose functions (for example, **print_twll**) to identify the type.

SCC Language Specification

The SCC language is quite simple. You identify the class name, the name of the superclass, the data definitions, and method definitions. All code is done in straight C, using a special function called **Send** to send messages. The data definition is the same as any structure definition. Here is the grammar:

```
Class name-of-class : name-of-super-class
{ C style declarations } (optional)
Methods: (optional)
  message-name(parameters) { C code }
  message-name(parameters) { C code }
```

Comments begin with a pair of slashes (//) and continue to the end of the line. Everything between the curly braces ({ }) is standard C; therefore, comments inside must be in standard C format. Here is an example:

```
Class TwllHead:ObjRoot {
   Obj top;          /* comment */
   int count;
   }
   Methods:
       AddItem()         // comment
       { ... }
```

TwllHead is the class being defined, and ObjRoot is the superclass. "top" and "count" are two data items added to ObjRoot's data. "AddItem" is a message that TwllHead can receive.

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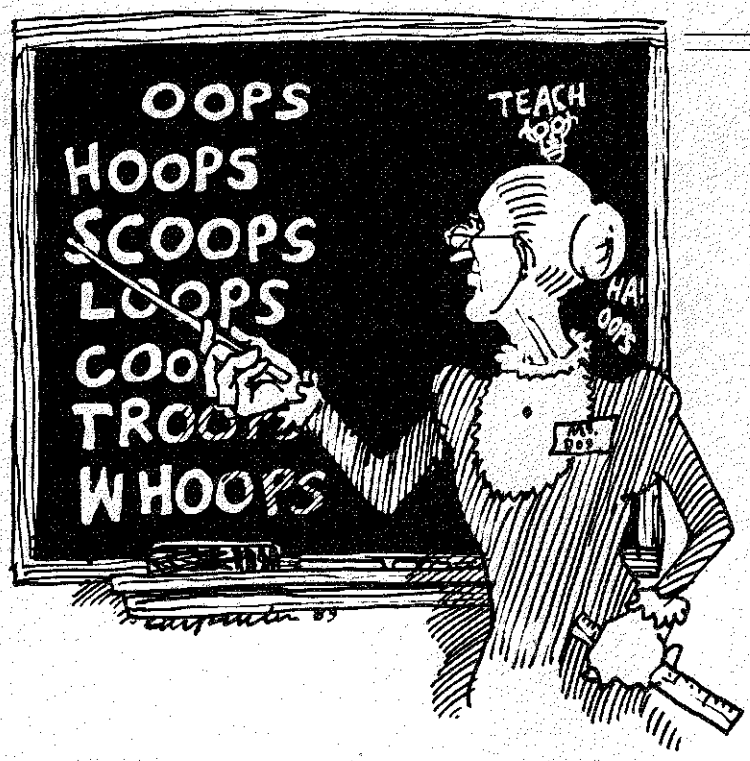

Converting to Object-Oriented Programming Names

Structures as Classes

Rather than calling these "nested structures," call them "class definitions." The TWLL, DATA_TWLL, and MY_DATA_TWLL structures are each a class: TWLL is the root class, DATA_TWLL is a subclass of TWLL, and MY_DATA_TWLL is a subclass of DATA_TWLL. This is because MY_DATA_TWLL uses DATA_TWLL, which uses TWLL. We can also say that TWLL is a superclass of DATA_TWLL and DATA_TWLL is a superclass of MY_DATA_TWLL.

You might think that since DATA_TWLL contains a TWLL, it is the superclass. This is only natural, since DATA_TWLL has more information, but don't look at it that way. Think instead of TWLL as the parent and DATA_TWLL as "inheriting" the genes of TWLL and adding genes of its own.

Nesting as Inheritance

In OOP terms, this combining of structures to create more-advanced ones is called *inheritance*. Inheritance can be viewed as simply borrowing field definitions from another source. In our example code, the **structs** that use the TWLL functions must "inherit" the two pointer fields before they can make use of the link-list functions.

Let's summarize what we have in the code examples: a structure containing two pointers, a set of functions that operate on these pointers, and a set of structures that can make use of these functions by inheriting the two pointers (consistently placed at the beginning of the **struct**).

If you look closely at Figure 1, you'll notice that DATA_TWLL is inherited by MY_DATA_TWLL. This means that you can call a function that expects a DATA_TWLL with a MY_DATA_TWLL structure, since we were consistent in how we created the structures. The order was always the same: TWLL then DATA_TWLL, and finally the MY_DATA_TWLL information. Also, OTHER_DATA_TWLL inherits from DATA_TWLL. Therefore, the DATA_TWLL functions can be used by OTHER_DATA_TWLL structures, but MY_DATA_TWLL and OTHER_DATA_TWLL cannot share functions.

This method requires a lot of careful planning on the programmer's part. In an OOP system, this is made much simpler and always produces the necessary consistency.

Message Passing vs. Virtual Functions

There are two ways in which functions (methods) are tied to data types to allow you to override methods: with messages and with virtual functions. Messages are typically implemented internally as simple integers, which are stored in a table for each class. Each table entry has the message and a pointer to the function that handles the message for the associated class. When you send a message such as

```
Send(head,AddItem,x);
```

the **Send** function uses a pointer stored in the object "head" to find the class table. The message "AddItem" is then located in the table to find the right function, and control is passed to that function. There are many different methods used to look up the message. SCC uses a hash table to minimize the number of comparisons and to improve performance. In fact, message passing can provide better performance and take less code than the equivalent system using numerous switch statements (see Listing 3).

C++ uses virtual functions. Internally, when you first define a virtual function, C++ creates room in the structure (class definition) for a pointer to a table. The addresses for the virtual functions are kept in the table at offsets managed by the compiler. When you invoke a virtual function, the compiler generates code to use the pointer stored in the object, increments it based on the function name, grabs the function address from there, and calls it.

Using virtual functions is almost always more efficient than sending messages, but the difference is negligible. This slight performance improvement is not free: Every time you add a function to a base class, you must recompile all the child classes and any module that uses any of the classes. In addition, the C++ compiler I use seems to take as long as the C compiler, for a total of two times longer than straight C; so, minor changes can take quite a long time. In a message-passing system, only changes to the data definition require recompiling, and then only the subclasses that are affected. SCC accomplishes this by maintaining a global file that has all the class names and message names and numbers.

There is another advantage to message passing. With virtual functions, implementing the **Print** method (which has different versions for each subclass) is quite simple. However, to produce the same effect as the **SendAll** method, you need to add a **Print** method to the root class TWLL and pass a pointer to a virtual function to the **SendAll** function. This is not obvious in C++ and requires some strange constructs.

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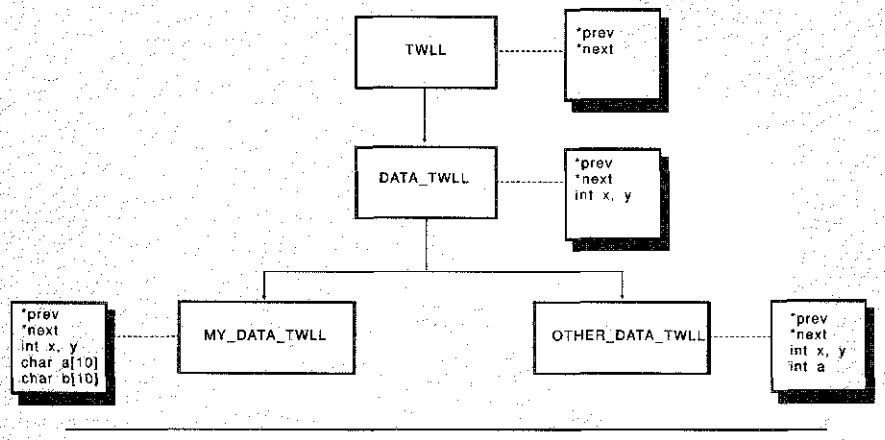

Figure 1. Hierarchy of structures used in TEST.C

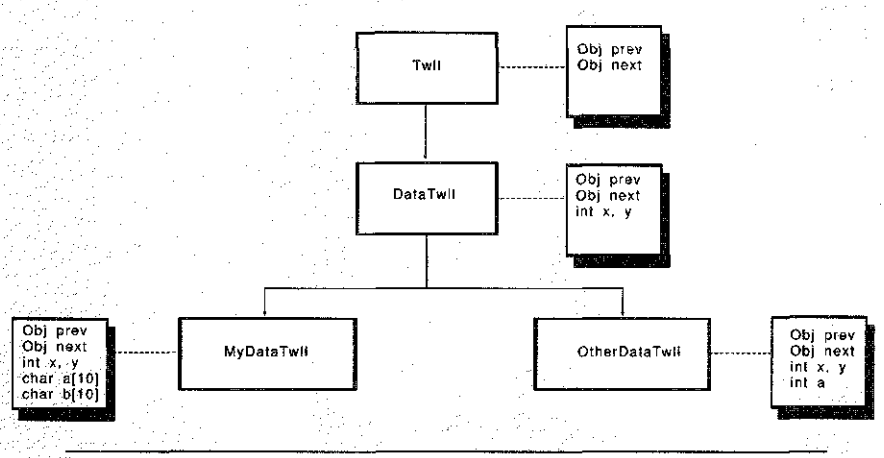

Figure 2. Hierarchy of classes used in TEST2.C

Functions as Methods

In reality, a class is more than the structure definition: It includes the functions that operate on the structure. While C does not "tie" together structures and functions, OOP languages always do. These functions that are linked to a structure are called *methods*.

For instance, the method **print_twll** is part of the TWLL class, because it operates on the TWLL structure. So, you can think of the structure DATA_TWLL and all the methods that work on this structure as a class.

A method always receives a pointer to the data type it operates on. Look at the functions in COOP.C (Listing 3). All of them receive a pointer as their first parameter. If you look at OOP.CLS (Listing 5), you will notice **self->** in all the methods, but **self** is never declared. Since methods always receive a pointer to the object, OOP compilers always add it for you. C++ uses the special identifier **this**, but the idea is the same. So, when you are coding a method, **self** is always a pointer to a structure that matches the class you are working on.

A class definition, therefore, has three parts: the identification of the superclass, its own data fields, and the list of methods that operate on the class. These functions are really a special form, and that is why we don't just call them functions. Look at the function **add_twll**. It operates on the TWLL structure. But is that really all? No, it can handle any structures that start with a previous or next pointer, for example, DATA_TWLL. These example functions and structures are brute force. Later, we will look more closely at how an OOP system ties functions and structures together with their superclasses to form a complete, correct class.

Messages vs. Function Calls

So, methods are just functions belonging to a structure definition. In TEST.C (Listing 1), the functions are called directly. However, in an OOP setup, methods are invoked by the sending of messages. Among other things, messages prevent the wrong function (that is, method) from being called. Another way to put it is that messages are used to invoke the method belonging to a piece of data.

TEST.C (Listing 1) and COOP.C (Listing 3) contain **switch** statements that check a type indicator so that the proper function will be called. This creates horrendous maintenance problems: Every time a new type is created, numerous **switch** statements need to be updated. Message passing avoids this problem, as we'll see later.

Also in COOP.C are four print functions. They all print, but there is one for each type of data. Isn't it more natural to have one function name called **Print** and define it differently for each data type? Look at OOP.CLS (Listing 5). There are still three print functions, but they are tied to their data types. Now compare TEST.C (Listing 1) and TEST2.C (Listing 4). In TEST.C, you have to determine the type and call the right function. In TEST2.C, you just send **Print** to all the members in the link list, and the system resolves which function to call.

If you think about it, functions *do* things. We naturally name them with verbs: read, write, open, close, and so on. More than that, functions do their things to the data that is passed. So, functions operate on data. In OOP, the focus is on data. Elements of data exist, and you want the data to do something, so you "send a message" and let the data determine how to accomplish it. You could sum it up by saying that traditionally, you ask a function to operate on some data, while with OOP, you ask the data to perform a function.

Objects

We've really come a long way in our analogy, and finally it's time for a definition: An *object* is a location in memory that contains data and that has been **malloc**ed to contain a

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structure. This is a simple description, but one that is often overlooked.

In the following example, *abc* is the definition, or name, of the structure, and *def* is an occurrence of *abc*:

```
struct abc {int a, b;};
struct abc def;
```

That is, *abc* is the definition, or class, and *def* is the instance, or object.

So, what's the difference between an object and any other variable? Well, objects contain pointers to special processing information. This includes things like their size, the name of their class, and a list of messages and methods. The important point to keep in mind for now is that objects are simply areas in memory.

The code in COOP.C (Listing 3) does solve the problem of using a single set of functions to handle varying TWLLs, even with different structure types linked together. However, there are some problems. For one, adding new types means maintaining **switch** statements scattered throughout the program. For another, nested structures can lead to messy code, such as

```
item->inherit.inherit.prev
```

and allocating memory for structures can look like

```
xyz=(struct DATA_TWLL *)calloc(sizeof(struct
        DATA_TWLL),1);
```

If there were a way to identify superclasses without nesting, tying structures to their functions, and sending messages rather than calling functions, we would have it. That is exactly what the language extensions for object-oriented systems are for.

C Language Extensions: A Better Solution

There are several extensions to the C language that allow you to define classes, subclasses, messages, and methods. The samples provided in this article were created using SCC. The examples could also be expressed in much the same way using Objective-C, C_talk, or any of the now common object-oriented extensions to C. C++ also allows for defining classes and subclasses and provides an effect similar to message passing, called virtual functions (see sidebar).

Creating Objects

In any of the languages, creating objects is fairly consistent. Since objects are basically chunks of memory, they are created with **malloc** or some such function. Here is an example using SCC:

```
Obj    abc;
abc=New(TwllHead);
```

New is quite simple. Given the class name (which is actually a pointer to the class-definition information) it **calloc**s a block of memory the size of an object of that class type. It then sets a pointer in the beginning of the block to the class's dispatch table and returns a pointer to the block.

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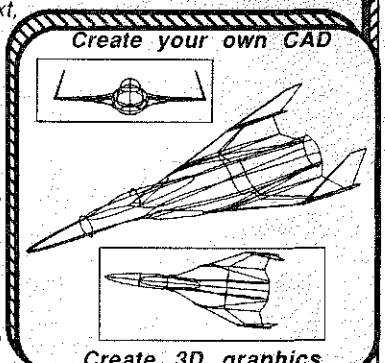

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Obj is actually just a void pointer; it is used, though, to make the code more readable. Unless you know the class of **Obj,** you don't know the layout of the data. This is actually desirable—it is called *data hiding*, and all OOP systems provide it. The only way you can access the information in an object is by sending a message to it. This allows the designer of the class more control over how the data is accessed and how the data is represented. Both C++ and SCC provide ways to access the data directly—in C++ you specify the data as public, and in SCC you can cast **Obj**—but neither is recommended.

Sending Messages

Sending messages is where OOP programming takes off. It might seem at first that there is no advantage to sending a message over making a function call, but take your time. First look at how messages are sent, and then you'll see how a single message could invoke one of any number of functions depending on the class of the object. Look at OOP.CLS (Listing 5). Notice that there are three functions called **Print**. This is polymorphism—the same function with multiple implementations. When **main** sends **SendAll** with the message **Print** as a parameter, **SendAll** passes on the message **Print** to all members of the linked list. (The code for this is in OOP.CLS in class TwllHead, method **SendAll**). Since **Send** uses the object to locate **Print**, the right version of **Print** will always be called!

Let's look at this a little more closely. Examine the following code:

```
Obj    x, y;
x=New(MyDataTwll);
y=New(OtherDataTwll);
...
Send(x,Print);
Send(y,Print);
```

You already know about **Obj** and **New**. The issue here is **Send**. We want these two objects to print themselves. We don't care what they are; we just want to see their contents. So we send **Print**.

The two **Send** lines look like they do the same thing, and in a way they do. However, MyDataTwll and OtherDataTwll have each implemented **Print**. **Send** ensures that the right version of **Print** is invoked for both *x* and *y*. Without OOP, you would have to code numerous **if-or switch** statements to determine types.

This ability to change the flow of control based on data is called *dynamic*, or *late, binding*. If you are used to knowing the exact flow of control in your programs, you'll have to take a deep breath and relax. In conventional programming, you knew facts such as **A** calls **B** and **B** calls **C**. In OOP programming, all you know for sure is that the method **A** for class X calls **B**. You don't know whose version of **B** will get called, because that is determined by the data and you don't know what type of data you were passed.

You might think everything would get out of hand very quickly. It doesn't. It is not long before you learn to focus your attention on specific types of data and specific methods and let the system worry about which calls what when.

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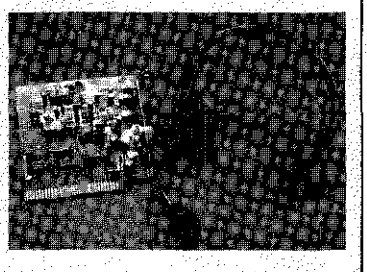

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Overriding Methods

In OOP.CLS (Listing 5), you saw that the message **Print** was defined in three different classes: DataTwll, MyDataTwll, and OtherDataTwll. Since MyDataTwll is a subclass of DataTwll, the **Print** message in MyDataTwll is an *override;* in other words, we told the SCC compiler that MyDataTwll has its own version of **Print**. So, when the message **Print** is sent to a MyDataTwll object, the function **MyDataTwll_Print** is called, instead of **DataTwll_Print**.

This is a very important attribute of OOP programming. So, let's see how it works, using the following code:

```
Obj    abc, def;
abc=New(DataTwll);
def=New(MyDataTwll);
Send(abc,Print);
Send(def,Print);
```

Send gets *abc* first. It finds the dispatch table for DataTwll (the class of object *abc*) and discovers that the function for **Print** is in class DataTwll. Control is passed. Internally, the function is named **DataTwll_Print**. This avoids problems, since LINK can't handle three functions all called **Print**.

Send then gets *def*. It finds the dispatch table for MyDataTwll and discovers that the function for its **Print** is **MyDataTwll_Print**. Control is passed.

Now, what if we say:

```
Send(def,SetX);
```

Message **SetX** is not defined for MyDataTwll. But it *is* defined for its superclass, DataTwll. This time, **Send** passes control to **DataTwll_SetX**. This is inheritance: Just as MyDataTwll inherits the data definition from DataTwll, it also inherits the methods. Therefore, we say that a subclass can do anything that its parent can do.

Passing Messages on to the Superclass

In the above example, we saw how the message **Print** was dispatched to the right function. Now, sometimes we don't want to override the original method; we only want to supplement it. For example, **DataTwll_Print** prints something that we wish for MyDataTwlls. We could repeat the code, but there is a better way.

The perfect solution is to pass control to the superclass's **Print** method. This is done with the **SendSuper** function. Look at **MyDataTwll_Print**. After it prints its part, it calls **SendSuper**. This passes the message "up the chain." Now, **DataTwll_Print** gets the opportunity to do its thing.

Style Differences

Object-oriented programming is a combination of programming language tools and style. In general, conventional programs are organized by the code; that is, you tend to think in terms of the **main** module or function, its subfunctions, their subfunctions, and so on. The organization of data and the relationships between differing types are "hard coded" and used as needed.

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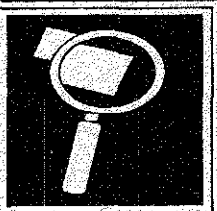

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When using object-oriented tools, you think in terms of data. There are base types of data, data types derived from the base types, types derived from these, and so on. Also, the code for each data type is tied to the data definition.

The difference can almost be summarized as data used by code (conventional) versus code used by data (OOP). This results in a fundamentally different organization of a program and a different way of looking at your programming problems.

Program execution is not quite the same, either. In an object-oriented application, the program will usually start life by creating a single object. This object is then "sent a message"—something like "Go." This object will then create other objects, which in turn create more objects. Objects are constantly being created, sending messages to one another, and dying. As the application winds down, more and more objects complete their tasks and die. Finally, the first object sends itself "Kill" (or some similar message), dies, and returns control to **main**.

Object-oriented programming is much more than just style. Without language extensions of some kind, it is almost impossible to manage your code. The only real way to get a feel for OOP is to try it. Pick up a copy of SCC, C++, or one of the many other fine products available today, and jump in. PJ

Steve Sando is currently working with Application Development Systems. He has been designing and writing commercial software products for IBM micros and mainframes for the past ten years. You can contact Steve via CompuServe, user ID 76357,1327.

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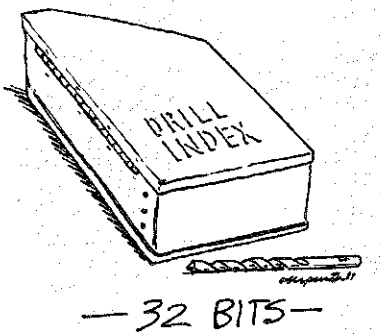

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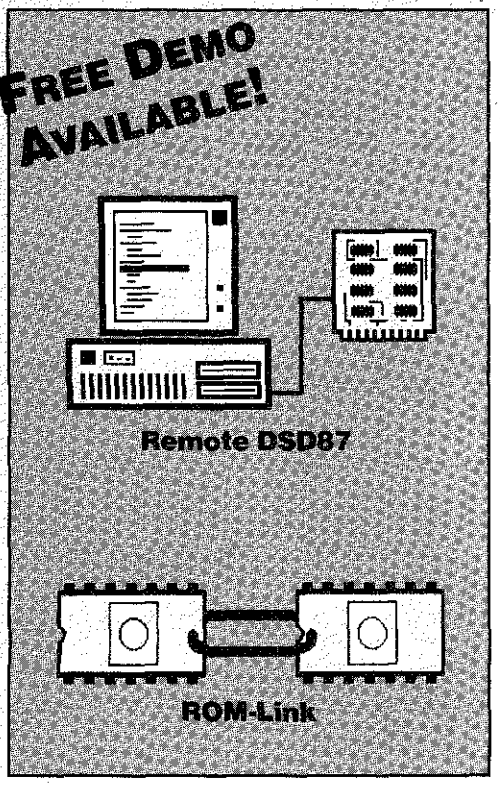

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Code from "From C to Objects," by Steve Sando

1

LISTING 1

```
/* TEST.C - Test the twll functions */
#include "stdio.h"
#include "malloc.h"
#include "coop.h"

/* This is the TWLL header that contains the top of the list pointer */

struct TWLL_HEAD header={0};

main()
{
    int      x;
    struct DATA_TWLL        *twll_item;
    struct MY_DATA_TWLL     *my_twll_item;
    struct OTHER_DATA_TWLL  *other_twll_item;

    /* add 3 entries of each type to the list */
    for (x=3;x;x--) {
        twll_item=                          /* create a new DATA_TWLL */
            (struct DATA_TWLL *)
            calloc(sizeof(struct DATA_TWLL),1);

        add_data_twll(&header,twll_item,DATA);
        twll_item->x=x;

        my_twll_item=               /* create a new MY_DATA_TWLL */
             (struct MY_DATA_TWLL *)
            calloc(sizeof(struct MY_DATA_TWLL),1);

        add_data_twll(&header,my_twll_item,MY_DATA);
        strcpy(my_twll_item->a,"Sample.");

        other_twll_item=                /* create a new OTHER_DATA_TWLL */
             (struct OTHER_DATA_TWLL *)
            calloc(sizeof(struct OTHER_DATA_TWLL),1);

        add_data_twll(&header,other_twll_item,OTHER_DATA);
        other_twll_item->a=x+100;
        }

    /* print the contents of the list */
    printf("printing lines in current list \n");
    for(twll_item=header.top;
        twll_item;
        twll_item=twll_item->inherit.next) {

        switch (twll_item->inherit.type) {
            case DATA:
                print_data_twll(twll_item);
                break;
            case MY_DATA:
                print_my_data_twll(twll_item);
                break;
            case OTHER_DATA:
                print_other_data_twll(twll_item);
                break;
            }
        }

    exit(0);
}
```

2

LISTING 2

```
/* COOP.H - contains structures for simulated Objects */
// -----------Structure TWLL-----------------------------------------
//  This is our root structure or Super Class.
struct TWLL {
    struct TWLL *prev;
    struct TWLL *next;
    int     type;
#define DATA    1
#define MY_DATA     2
#define OTHER_DATA 3
  };

// -----------Structure TWLL_HEAD------------------------------------
//  This is our header struct for the linked list
struct TWLL_HEAD {
    struct TWLL *top;
    int   cnt;
    };

// -----------Structure DATA_TWLL------------------------------------
//  Here is a struct that inherits two pointers from TWLL.
//  By always placing TWLL at the beginning then
//  TWLL functions can make the assumption that both pointers
//  are at the start of the structure.
struct DATA_TWLL {
    struct TWLL inherit;
    int x;
    int y;
    };

// -----------Structure MY_DATA_TWLL---------------------------------
//  Here is a stuct that inherits the two
//  pointers from TWLL and the x and y fields from DATA_TWLL.
struct MY_DATA_TWLL {
    struct DATA_TWLL inherit;
    char   a[10];
    char   b[10];
    };

// -----------Structure OTHER_DATA_TWLL------------------------------
//  Here is one last structure using TWLL and DATA_TWLL.
//  Since it uses the same structure (DATA_TWLL) as MY_DATA_TWLL,
//  this class is a sibling of MY_DATA_TWLL
struct OTHER_DATA_TWLL {
    struct DATA_TWLL inherit;
    int a;
  };
```

LISTING 3

```
/* COOP.C - functions to handle twll structure and related structures */
    add_twll()              - insert a new item on the top of the list
    add_data_twll()         - add a new data_twll item by calling add_twll()
    print_twll()            - print a description of the item's type
    print_data_twll()       - print values and call print_twll()
    print_my_data_twll()    - print values and call print_data_twll()
    print_other_data_twll() - print values and call print_data_twll()
*/
#include "coop.h"
/* Add a new item to the top of a two-way linked list */
add_twll(head,twll,type)
struct TWLL_HEAD *head;
struct TWLL *twll;
int             type;
{
    struct TWLL *cur;

    cur         =head->top;
```

Code continues . . .

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Sandō code, continued

3

```
    twll->prev =0;
    twll->next =cur;
    if (cur) {
        cur->prev  =twll;
        head->top  =twll;
        head->cnt++;
        }
    head->top=twll;
    twll->type=type;
}
/* This function inits any struct that starts with DATA_TWLL.
 These structures must have x and y inited to 5 and 6.
 It then calls the regular add function to insert the struct.
*/
add_data_twll(head,twll,type)
struct HEAD_TWLL *head;
struct DATA_TWLL *twll;
int              type;
{
    twll->x=5;
    twll->y=6;
    add_twll(head,twll,type);
}
/* Print the data type */
print_twll(twll)
struct TWLL *twll;
{
    switch (twll->type) {
        case DATA:
            printf("type is DATA\n");
            break;
        case MY_DATA:
            printf("type is MY_DATA\n");
            break;
        case OTHER_DATA:
            printf("type is OTHER_DATA\n");
            break;
        }
    return;
}
/* Print the data in a DATA_TWLL */
print_data_twll(twll)
struct DATA_TWLL *twll;
{
    printf("x is %d, y is %d \t",twll->x,twll->y);
    print_twll(twll);
}
/* Print the data in a MY_DATA_TWLL */
print_my_data_twll(twll)
struct MY_DATA_TWLL *twll;
{
    printf("a is %s \t",twll->a);
    print_data_twll(twll);
}
/* Print the data in an OTHER_DATA_TWLL */
print_other_data_twll(twll)
struct OTHER_DATA_TWLL *twll;
{
     printf("a is %d \t",twll->a);
     print_data_twll(twll);
}
```

LISTING 4

```
/* TEST2.C - Same as TEST.C, except using objects */
#include "stdio.h"
#include "pubclass.h"

main()
```

4

```
{
    int x;
    Obj item;
    Obj header=New(TwllHead);

    /* add 3 entries of each type to the list*/
    for (x=3;x;x--) {
        item=New(DataTwll);         /* create a new DataTwll Object */
        Send(header,AddItem,item);
        Send(item,SetX,x);

        item=New(MyDataTwll);       /* create a MyDataTwll */
        Send(header,AddItem,item);
        Send(item,SetA,"Sample.");

        item=New(OtherDataTwll);    /* create an OtherDataTwll */
        Send(header,AddItem,item);
        Send(item,SetA,x+100);
        }

    /* print the contents of the list */
    Send(header,SendAll,Print);

    exit(0);
}
```

LISTING 5

```
//    OOP.CLS - Methods for two way linked lists
Include "Root.cls"

// ------------Class TwllHead---------------------------------------

Class TwllHead : ObjRoot{
    Obj     top;
    int     cnt;
    }
Methods:

// ----------------------------------------------------------------
// Add a new twll item to a list
AddItem(Twll_s *twll)
    {
        struct Twll_s *cur;

        cur        =self->top;
        twll->prev =0;
        twll->next =cur;
        if (cur) {
            cur->prev  =twll;
            self->top  =twll;
            self->cnt++;
            }
        self->top=twll;
        return;
    }

// ----------------------------------------------------------------
// This method passes a message on to all the Objects in the list.
SendAll(int pass_msg)
    {
        Twll_s      *x;

        for(x=self->top; x ;x=x->next)
            Send(x,pass_msg);
        return;
    }

// ------------Class Twll-------------------------------------------
```

Code continues . . .

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Sando code, continued

5

```
//  Abstract Root class for all object that can be added to a list
Class Twll : ObjRoot {
    Obj     prev;
    Obj     next;
    }

// ------------Class DataTwll-----------------------------------------
Class DataTwll : Twll {
    int     x, y;
    }

Methods:

// ------------------------------------------------------------------
// Initialize a DataTwll object for x and y
int ObjInit()
    {       // init x and y
        self->x=5;
        self->y=6;
        SendSuper(SuperDataTwll,msg);           /* pass the init msg up */
        return;
    }

// ------------------------------------------------------------------
// Set the value of X
SetX(int x)
    {
        self->x=x;
    }

// ------------------------------------------------------------------
// Print the contents of a data TWLL
Print()
    {
        printf("x is %d, y is %d \t",self->x,self->y);
        Send(self,ObjPrintName);
    }

// ------------Class MyDataTwll---------------------------------------
Class MyDataTwll : DataTwll {
    char    a[10], b[10];
    }

Methods:

// ------------------------------------------------------------------
// Print the contents of a MyDataTwll
Print()
    {
        printf("a is %s \t",self->a);
        SendSuper(SuperMyDataTwll,msg);
    }

// ------------------------------------------------------------------
// Set the value of a
SetA(char *str) { strcpy(self->a,str); }

// ------------Class OtherDataTwll------------------------------------
Class OtherDataTwll : DataTwll {
    int     a;
    }

Methods:

// ------------------------------------------------------------------
// Print the contents of an OtherDataTwll
Print()
    {
        printf("a is %d \t",self->a);
```

6

```
        SendSuper(SuperMyDataTwll,msg);
    }

// ------------------------------------------------------------------
// Set the value of a
SetA(int a)
    {
        self->a=a;
    }

// ------------------------------------------------------------------
OtherCode {
abort_msg(char *msg)
{
    puts(msg);
    exit(1);
}

}
```

LISTING 6

```
typedef int (*funcp)();

typedef struct METH_T {
    int    msg;                 // msg on top to improve compare time
    funcp  procc;               // pointer to method for msg
    struct METH_T near *next;   // next entry in this hash chain
    } METH_TABLE;               // entry in method table

#define MAX_METHS 32            // must be multi of 2
typedef struct class_def {
    METH_TABLE near *tbl;       // pointer to method table for this class
    char       *name;           // asciiz string of class name
    int        size;            // size of objects in this class
    struct class_def  *super;
    METH_TABLE near *hash[MAX_METHS]; // hash table for method look-ups
    } CLASS_DEF;

typedef struct {
    CLASS_DEF near *class;
    } *Obj_x;

/*-------------------------------------------------*/
void *send(obj,msg)
Obj_x obj;
int msg;
{
    METH_TABLE  near *tbl;
    CLASS_DEF   near *clas;
    int hash;

    hash=msg & (MAX_METHS-1);

    clas=obj->class;
    if ( !(tbl=clas->hash[hash]) ) {
        send_org(clas);                     // initialize the hash table
        tbl=clas->hash[hash];
        }

    while (tbl->msg != msg)                 // search hash chain for msg
        tbl=tbl->next;

    (*tbl->procc)();                        // NOTE:
                                            //  need to convert this to a jump
    return;
}
```


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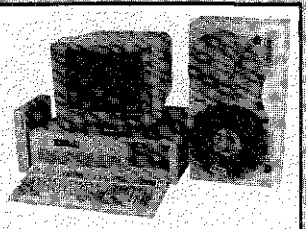

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Better C++ Code Generation

by

John M. Dlugosz

Did you ever look at the code generated by a C++ compiler? C++ compilers that generate C code for output are at the mercy of the C compiler they translate for. But a native code compiler generates native code directly from C++ and is not limited to explaining C++ features in terms of C features. There are ways to improve the ideas behind the compiler to produce better code.

Consider parameter passing. In C, all parameters are passed by pushing them on the stack. For large values, you might decrement SP and then do a block copy, but it amounts to the same thing. In C++, values are passed by initialization; that is, the space on the stack that will correspond to the local variable in the called function is given a value in the exact same way an auto variable is initialized. For many types, this requires calling a constructor.

A translator would do something like this:

```
extern foo (mytype x);
// a C++ call
foo (avalue);

//translates to:
struct mytype temp;    /* temporary variable */
mytype_copy_constructor (&temp, &avalue);
foo (&temp);
mytype_destructor (&temp);
```

The translator initializes a temporary variable and passes that. There is no other way a translator could do this. What is shocking is that the native code compiler generates worse code! It makes a copy and pushes the copy by value. The translator passed the copy's address, which was faster. What a native code compiler could do is just construct the thing in the proper place. Consider the following fragment, produced by Zortech 1.07 for MS-DOS:

```
;foo (avalue);
      lea AX,[BP-5Ch]
      push AX          ;address of avalue
      lea CX,[BP-2Eh]
      push CX          ;address of temp
      call __mytype__ctorFRCmytype___
      add SP,4         ;copy made
      lea BX,[BP-2]
      mov CX,017h      ;size of object to push
L28:  push [BX]        ;loop to push the copy on stack
      sub BX,2
      loop L28
      call _foo        ;call foo
      add SP,2Eh
      xor AX,AX
      push AX
      lea CX,[BP-2Eh]
      push CX
      call __mytype__dtor  ;get rid of temp
      add SP,4
```

You can see that the loop to push the copy costs both time and stack space. The translator's output, once compiled, looks the same except that the copy's address is passed instead of its value, eliminating the loop. It would be better if the stack location were the destination of the copy in the first place. This would speed it up, make it shorter, save a large auto variable, and result in a stack frame looking exactly as if a copy were pushed by value, the way Zortech did it:

```
;foo (avalue);
      sub SP,2Eh       ;room for parameter on stack
      mov CX,SP        ;address of this area
      lea AX,[BP-5Ch]
      push AX          ;address of avalue
      push CX          ;address of foo's local copy
      call __mytype__ctorFRCmytype___
      add SP,4         ;copy made
      call _foo        ;call foo
      mov CX,SP
      xor AX,AX
      push AX
      push CX
      call __mytype__dtor  ;get rid of temp
      add SP,4 + 2Eh   ;clear stack from call and the
                       ; variable
```

If the compiler used this sequence instead, the program would run faster, and nothing else about the compiler would need to change. These examples are in the small-memory model. In the large model, the savings are even greater, but the listings are more cryptic. You should get the general idea from the small model.

Returning Values

The inefficiency of return values can be bad, too. In C, the ability to return a structure is relatively new. Upon finding out that it was possible in Microsoft's compiler, I looked at the code produced and decided not to use this feature. In C++ however, it is a common thing to do.

The traditional way of returning a large value is by way of an internal static buffer. The function actually returns a pointer to this buffer, and the caller copies it out. Here is another example from Zortech:

```
;    end of function foo()
;return x;
      lea SI,[BP-2Eh]  ;address of local variable x
      mov AX,DS        ; in DS:SI
      mov ES,AX
      mov DI,offset DGROUP:U0     ;address of static
      cld                         ; buffer in ES:DI
      mov CX,017h
      rep movsw                   ;copy it
      mov AX,offset DGROUP:U0     ;return pointer
                                  ; to buffer
      pop DI                      ;return sequence
```


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```
        pop SI
        mov SP,BP
        pop BP
        ret

;     use of function
;avalue= foo ();
        call _foo
        mov SI,AX
        mov AX,SS
        mov ES,AX
        lea DI,[BP-2Eh]
        cld
        mov CX,17h
        rep movsw
```

The function returns a structure. As part of the return process, the value is copied into a static memory area. The address of this buffer is returned, and the caller copies it again to the destination. If the function had not been in an assignment statement but had been part of a larger expression, it would have been copied to a temporary variable (which would then be passed to a destructor after the value was no longer needed).

You can see that this technique is very wasteful: Not only does the multiple copying slow down the program, but the static buffer is used by only this one function, and buffers for many functions can put a dent in the memory requirements of the program.

According to the Zortech manual, the functions that return in this manner are not reentrant, because the static buffer gets overwritten on each call. The manual is incorrect: Because the value is not copied into the buffer until the return statement of the function, and the caller immediately copies it out again, no function can be called while this buffer contains anything. So, contrary to the instructions, such functions are fully reentrant.

A close look will show that one buffer will do for all functions in the entire program. The buffer needs to be large enough for the largest structure returned by value. A great deal of memory could be saved if the compiler adopted a single buffer system. Furthermore, if only one buffer is used, there is no need to have the function return its address in a register: The caller will know where to find it and can load SI with a literal.

Using this buffer technique, you can reduce the amount of buffer memory needed and shave off a couple instructions. But the technique is still rather bad. The obvious improvement would be to change the calling mechanism. The caller could tell the function where it wants the answer by passing an extra parameter that is a pointer to the answer area. This would remove the second copying. Furthermore, the optimization process could ensure that the copy were built there in the first place, eliminating the first copying: If an auto variable is returned (this includes temporary variables), replace its use throughout the function with the use of the return area, and delete its destructor. This would improve speed considerably. The optimizer cannot do that now because of the reentrance problems: The static buffer must be filled just before the return in order to produce a reentrant function.

When Zortech C++ was first released, I pointed out to Walter Bright the cost of functions that return structures. He said he considered passing a hidden parameter to the answer area but decided against it because he wanted to keep the standard C calling convention. This is very costly in performance, because returning structures is so common in C++. Fortunately, future versions of the compiler are supposed to use the better method as well as provide C compatibility when requested.

Bjarne Stroustrup recognized this issue when writing Cfront, and he came up with an interesting compromise: A function that returns a structure is turned into a function that takes a hidden parameter if the translator knows that the function will not be called from C. It knows this will be the case if the value being returned (or any of the parameters) has a copy constructor. A similar improvement is made on all objects passed by value: Instead of copying the object into a temporary variable and pushing the temporary, the definition of the function is modified to pass a pointer to the temporary. This eliminates the loop used to push a large parameter and results in faster code with reduced stack usage.

Because of the differences between Bright's and Stroustrup's policies, a Cfront-based translator will generate better code than Zortech's native code compiler for function calls passing or returning class objects. A native code compiler could use the same techniques found in Cfront, which are architecture independent. However I would expect a native code compiler to do better then this and deal with the stack more directly, as described above.

Calling Conventions

Passing and returning class objects is an important part of C++, and generating good code for these operations does not require much change from methods used by C compilers. Any further improvements, however, do require that the function-calling convention be changed. Why is this an issue? After all, member functions already pass a hidden parameter, and "real" C functions cannot return structures, anyway. Adopting the convention that functions returning structures accept a hidden parameter for a return area would not bother anyone.

But why do we want compatibility with the traditional C calling convention? If I were linking with functions written in assembly language, I would care more about knowing what it is and not quite so much about exactly what it is. In a real program, I want good performance. Making sure the assembly language functions are executed correctly is a very minor part of a program.

Most C compilers now accept special forms of the **extern** statement to allow linkage with functions using different calling and naming conventions. C++ will require such a feature soon, when the new compilers start using type-safe linkage. Why not take this opportunity to break with the

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standard calling conventions along with the naming conventions? If you want to use your "old" assembly language functions, just specify the proper keywords when you **extern** them in the program.

How would you devise a calling convention for C++? Let's start by looking at two common conventions. The C convention is to push parameters from right to left, with the caller popping them off again. The other common technique (commonly called a Pascal call but actually a subset of the Pascal calling requirements) is to push parameters from left to right, with the called function clearing the stack when it returns.

The C convention was devised because in K&R C, no checking was done with parameter passing. Since the function did not know how many parameters were actually passed, it did not clear them; rather, the caller popped off whatever it pushed when it made the call. This was safer all around. Pushing right to left made a variable number of parameters useful; the first parameters are in the same place on the stack, even if the later parameters are missing.

The Pascal technique is more efficient. The program does not need extra code after each function call, and a special form of function return is usually available to clear the stack as it returns. Except for functions that take a variable parameter count, the called function ought to clear the stack.

In C++, "clearing the stack" does not mean just popping the parameters off during the return—it needs to call the destructors for the arguments first. This reduces the size of the program considerably. Rather than destructors being called after every function call, they are in there only once, at the end of the function itself. In this respect, the savings for using a Pascal-style function call is much greater for C++ then for other languages.

Whether the parameters are passed left to right or right to left doesn't mean beans. I suggest they be passed right to left so that they will be consistent with the variable parameter count functions.

C++ has another special consideration for function calls. A member function is not quite like any other procedural language feature. The function needs to know what instance it is operating on. This is usually handled by passing a pointer as a hidden parameter. Looking at the generated code, you see that this makes C++ rather inefficient.

Scope

Languages like C have two forms of scope: global and local. Two addressing forms in the CPU handle this easily. Pascal has a broader meaning of "scope" and sets up pointers on the stack to deal with variables of intermediate scope. This gives Pascal calls more overhead, and accessing these variables of intermediate scope is not efficient, because the pointer must be loaded first (as a variable of local scope) and the proper variable then must be found offset from it.

C++ has a novel idea of scope, but you can see it is not much different from Pascal's problems. The way it is usually accomplished is by passing a pointer as a hidden parameter. To access a member variable, the CPU first accesses the pointer (known as **this**) as a local variable and finds an address offset from it. While references to intermediate variables in Pascal can be avoided, references to member variables in C++ are extremely common.

I suggest that the **this** pointer be kept in a register. The instance would be passed in the register when a member function was called. It is common to have a member function call other members. In this case, the register is already loaded, and nothing further need be done. If a member of a different variable were called, the register would be saved by the caller before loading it with the new value. Some MS-DOS C compilers, such as WATCOM, can generate code to pass the first parameter in a register. Using such a compiler with a C++ translator can yield fantastic results.

C++ really has three scopes: global, local, and member. In a 68000-family CPU, one of the address registers can be reserved for the member pointer. All member variable references are relative to it. It is still set correctly when another member function is called; it is pushed and popped only when a different instance is being worked with.

In the 80X86 family, things are more difficult: There simply are not enough registers. The globals are absolute offsets in the data segment, and the locals are relative to BP in the stack segment. There is no corresponding segment for the member scope. I would suggest using DI in the small model. It is commonly used for register variables, and what makes a better register variable than the **this** pointer? For the large model, things are more complicated. ES:DI could be used, but ES is needed every time any pointer is used. SI:DI could be used and SI moved to ES when needed. A more radical solution might consider using DS, since global-variable accesses are rare and member-variable accesses are common.

A similar procedure can be used for functions that return a structure. The address of the destination should be supplied by the caller, and the function will place it there. This can be done on the stack, but a register might be better. In the 68000 family, one of the address registers can be reserved for this purpose. In the 80X86 family, SI could be used. (Even

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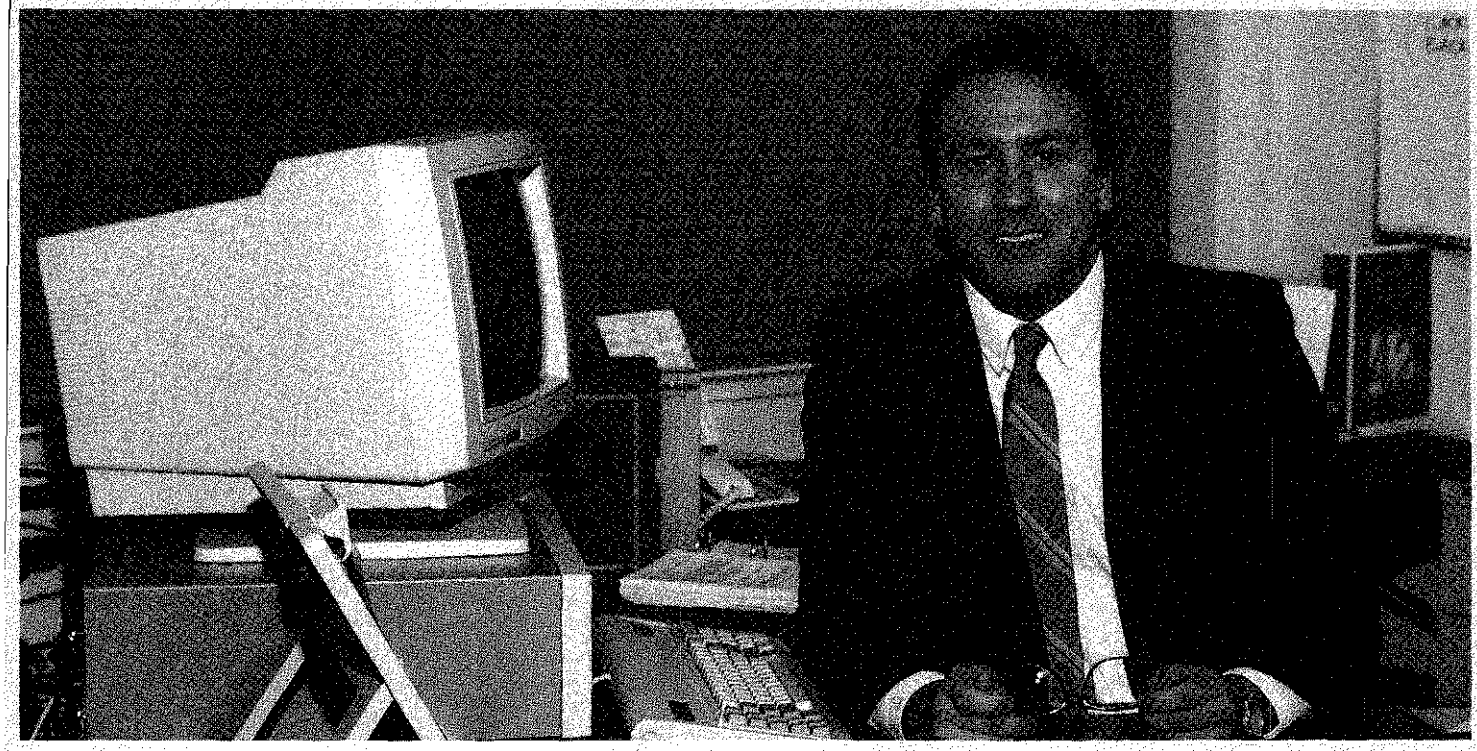

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in the large model, the stack segment can be assumed.) In large-model member functions, it would need to use the stack.

Let's take a look at how these improvements would affect the examples given earlier:

```
Call with copy constructor

;foo (avalue);
     sub SP,2Eh        ;room for parameter on stack
     mov DI,SP         ;address of this area
     lea AX,[BP-5Ch]
     push AX           ;address of avalue
     call __mytype__ctorFRCmytype___
     call _foo         ;call foo

Function returning a structure
;    end of function foo()
;return x;
; there is nothing to do, since the optimizer
; replaced all uses of local variable x with
; [SI]. The answer is already there.
      pop DI           ;return sequence
      mov SP,BP
      pop BP
      ret

;    use of function
;avalue= foo ();
      lea SI,[BP-2Eh]    ;where I want the answer
      call _foo
```

You can see even from these simple examples that the program compiles *much* better.

Another area where a native code compiler can't compete with a translator is static constructors and destructors. A native code compiler can generate code for static constructors (and destructors) that does not require the object or executable code to be patched. It can also handle constructors for static variables inside functions much more easily.

Consider three code segments, **a**, **b**, and **c**, defined in that order in a module in the library, with **a** containing a label **static_ctors**, **b** empty, and **c** containing a **RET** statement. Each translation unit generates its static constructor code in segment **b**. When the program is linked, all the static constructor code is sandwiched together between the label and the return statement. The startup code calls **static_ctors**. An analogous method can be used for the destructors.

Caveat Vendor

Native code compilers for C++ need to deal with more issues than C compilers. They can generate better code if they understand the C++ constructs, rather then expressing them in terms of C constructs internally. C++ can produce much better code than is seen in current implementations. Since C++ expresses higher-level ideas, the compiler can have a better idea of what is intended and generate better code then the equivalent C program.

I am afraid that the round of C++ compilers soon to appear from vendors of popular C compilers will not understand this and will generate lousy code. Vendors, listen to me! If you want the first round of published benchmarks to show code that is a third the size of and twice as fast as the competition's, look at the above examples carefully.

John M. Dlugosz is a programmer, consultant, and writer based in Plano, Texas. He is working on his first book, Advanced C++ Programming.

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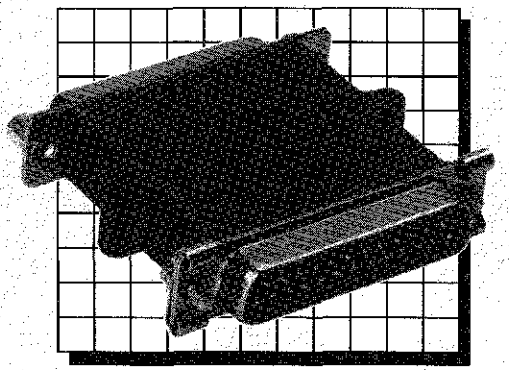

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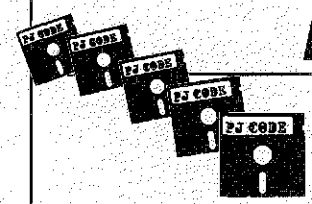

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A Library System for Assembly

by

John Otken

Libraries are essential tools for efficient assembly language programming, yet they are rarely used. Over the last several years, I have developed an automated system that simplifies the use and maintenance of libraries.

Since assembly language libraries are uncommon, we might review functions of libraries under the C language. A primary purpose of C libraries is to provide a rich selection of general-purpose routines that permit programmers to work more quickly through the use of pre-existing code. These routines, which are listed in the reference section of your manual, include functions for input, output, string operations, memory allocation, and various conversions. Turbo C documents more than 400 such routines.

A second purpose is to provide "hidden" routines for compiler support. For example, Turbo C does not know how to multiply two long integers, but it does know which library routine to call—in this case, LXMUL@. These compiler-support routines are undocumented and never called directly by a program.

```
long a=1, b=2, c;
c = a*b;  /* generates call to LXMUL@ */
```

Although an assembly language library has no requirement for undocumented routines, it should provide parallel functions of both the general-purpose and support categories. An advantage of moving support routines to a library is the reduction of clutter in the various modules; program code becomes focused.

A final purpose of any library is to provide a convenient way to collect multiple object files into a single file. At link time, only referenced modules are included in the program image. Not only does this use storage more efficiently, but it also helps eliminate routines from programs that are not referenced.

Most programmers consider a C compiler useless without its library. An assembler is no different, and the lack of a library is why many programmers use assembly language only to write subroutines for their C code. Providing a library would open many new applications for assembly language. The first step is to set a realistic goal. Whereas C defines up to five separate memory models and a library for each, I define a single assembly language model, a hybrid design combining the "small" C model with a large, dynamic storage space. Obviously, one library is much easier to program than five.

The next step is the use of a library maintenance system that automatically reassembles the library file and creates documentation on member routines. If you have ever tried to add routines to your C library, you will greatly appreciate this system; you might even try adapting the programs for use with C.

Unfortunately, I am not offering a rich selection of routines for your library, and, to my knowledge, no worthwhile library is available for purchase off the shelf. My personal library, however close to nirvana, is not available, although over time I will make portions available via this column. Check *PJ* 7.4 (July/August 1989) for some simple **outchr** routines and C-like **isdigit** and **strlen** functions.

In early development of this system several years ago, I wanted the capability to enhance and expand the library during the normal course of programming. The ability to "cut" a general-purpose routine from a module and "paste" it into a source template would permit the selection of routines to grow with minimal effort.

The first component of this system is LIBGEN, which writes the command files required to assemble updated source files and generate the actual library file. The program was initially designed to work with Microsoft's assembler and librarian, although I have enhanced it to work with the superior products offered by SLR Systems: OPTASM and OPTLIB. I have not tried this program with Borland products, but I presume that you can also use TASM and TLIB.

LIBGEN is a short C program that builds a list of the assembly language source files in a directory, sorts the list, and writes a MAKE file for MASM, a pseudoMAKE file for OPTASM, and a response file for LIB.

If you use Microsoft or Borland products, a batch file invokes LIBGEN and then runs MAKE, which invokes the assembler for those modules that require reassembly. The batch file deletes the current library file, LIB.LIB, and executes LIB to completely rebuild the library. Here is the MAKLIB batch file:

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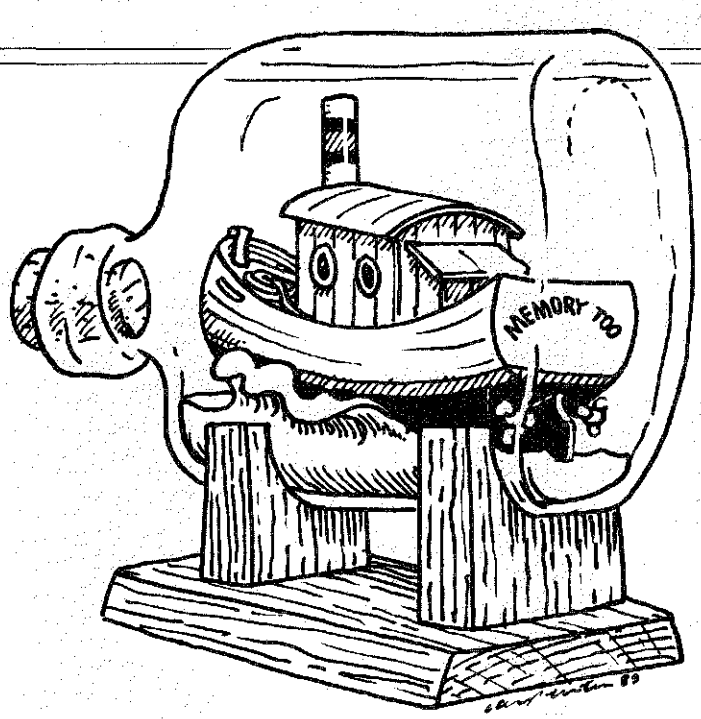


```
libgen *.asm
make lib.mak
if errorlevel 1 goto done
del lib.lib
lib @lib.arf
:done
```

The two annoying aspects of this method are that the OBJ files must remain in the directory at all times and that invoking the assembler for each module is slow. With more than 150 modules, my directory does not need the clutter of excess OBJ files, nor do I have the patience to watch an assembler execute 150 times when the master include file changes.

Fortunately, OPTASM and OPTLIB offer excellent solutions to both problems. OPTASM has a built in MAKE-like ability; not only do you not have to reload the assembler, but it even automatically buffers include files so that the assembly process proceeds at an incredible rate. OPTLIB has a useful, time-based replace feature that compares the creation time of an object file with the date stamp of the object file within the library and updates modules as required. Here is the MAKLIB batch file for use with OPTASM and OPTLIB:

```
libgen *.asm
optasm @lib.opt
if errorlevel 1 goto done
optlib lib -*;
del *.obj
:done
```

In one minute, OPTASM and OPTLIB completely rebuilt my library of 157 modules containing more than 14,000 source lines.

The source for the LIBGEN.C program appears in Listing 1. You can compile the program with either Microsoft or Turbo C. The program assumes source files are dependent on a LIB.EQU file, which is not covered in this column; for now, create a dummy LIB.EQU file. You must create a separate directory for your library source files, because LIBGEN assumes that all files in the current directory with an extension of ASM are part of the library.

The second component of this library system is a program that automatically generates documentation for the routines in the library. When a library has 600 entry points in 150 modules, you waste too much time searching for function definitions. A more efficient approach is to collect and organize the essential documentation for each routine into a single file.

The ASMHDR program performs precisely that task. It reads a list of assembly language source files, extracts the header comments, sorts the comments alphabetically, and writes the comments to a file. The resulting file is easy to reference while programming. I have a key defined in my editor to load the comment file; I just press the key and use the search feature of my editor to find the header comment for a particular function.

Recall that the previous column introduced header comments, which contain the important information about a function—namely the register entry and exit conditions. In the following example, the function **strskp** accepts a pointer to a string in registers DS:SI, returns a pointer to the byte past the NULL delimiter in SI, and bashes whatever was in the AX register:

```
;;    strskp
;
;     entry    DS:SI   string address
;     exit     SI      updated past \0
;     uses     AX
;
strskp proc
     lodsb
     cmp    al,0
     jne    strskp
     ret
strskp endp
```

The header comment provides a good description of the operation of this function and presents the information in an attractive and easy-to-read format.

The ASMHDR program is very simple, containing no logic to process the complex assembly language syntax defined by MASM. The program scans a text file for lines that start with a double semicolon followed by a tab. From that point, it collects text for all subsequent lines until a line begins with a character other than a semicolon. After collecting all such blocks of text from the entire list of files, ASMHDR sorts the header comments and writes them in order.

ASMHDR's limitation is that all header comments are processed, even those for routines that are strictly internal to a library module. An intelligent solution would involve reading PUBLIC statements and processing only those headers that appear in a PUBLIC, but that is not yet the case. In the meantime, you can easily defeat ASMHDR's search

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algorithm by altering the header comments that are not to appear in the document file:

```
;;*   internal lib routine
;
;     entry  AX  ...
;
```

Placing a "splat" character after the double semicolon will cause ASMHDR to skip this routine. One reason I reserve the double-semicolon syntax for header comments is to simplify programs such as ASMHDR. There are many such useful utilities you could create to make programming easier, and unless you want to write your own assembler, I suggest keeping the syntax of programs as simple as possible.

The source for the ASMHDR.C program appears in Listing 2. You can compile the program as is with Turbo C. Microsoft C users must change the name of an include file and comment out the **printf** statement that references the **coreleft** function.

The third component of the library system is a template file. To create a new module, substitute a title and procedure name for each x, fill in the header comments, drop in code for the procedure, and save the file with an appropriate name.

```
        title   x
        .model small
        .code
        public  x

;;      x
;
;       entry
;       exit
;       uses
;
x proc
x endp
        end
```

The template file is simple, but it saves time and keeps you from having to break your train of thought to create a new module.

This template does not reference a master include file, nor does it have a place for static data definitions. If possible, library routines should avoid static storage, because it limits the usefulness of the library for applications like multitasking. Ideal library routines are independent of memory models, with the exception of a near or far return instruction.

Using the Library

BEEP is as simple as programs get: With a press of Ctrl-G, it beeps the speaker and returns to DOS, calling two library routines, **outchr** and **ms_dos**, in the process. OUTCHR.ASM and MS_DOS.ASM appear in listings 3 and 4. Enter the two library routines, and execute one of the MAKLIB batch files from above to build the LIB.LIB library file. In a separate directory, enter BEEP.ASM:

```
        title   beep
        dosseg
        .model  small
        .stack
        .code
        extrn   outchr:near,ms_dos:near

;;      main
;
main    proc
        mov     al,7
        call    outchr
        mov     ax,4C00h
        jmp     ms_dos
main    endp
        end     main
```

I call or jump to an **ms_dos** routine instead of using the shorter, two-byte INT instruction because the technique is a useful debugging aid and a front-end routine can replace **ms_dos**, if necessary.

After entering the source for BEEP.ASM, assemble and link the program with commands similar to the following (substituting the names of your assembler and linker for "asm" and "lnk", respectively):

```
asm beep;
lnk beep,,,\lib\lib.lib;
```

You now have a BEEP program. Switch to the library directory, and run the ASMHDR program with

```
asmhdr lib.doc *.asm
```

Examine the LIB.DOC file; it contains the header comments from MS_DOS and OUTCHR.

This completes the automated library-maintenance system. I will add routines to this library on a regular basis, but you are responsible for the majority of library growth.

Register Usage

The increased performance of assembly language programs is due in part to important values remaining in the registers more often than they would in code generated by language compilers. This permits the use of register-to-register instructions, which are at least twice as fast as their register-to-memory equivalents.

Contrary to the claims of computer scientists and authors of high-level languages, MS-DOS compilers are not going to produce code that approaches the performance of even decent assembly language. Code generation is too difficult for the 80X86 architecture. When a programmer constructs an algorithm in a C program, he codes for an abstract machine that has no real-life equivalent. The compiler's job is to convert an algorithm from the abstract machine defined by C to the real hardware defined by the 80X86. This is essentially a conversion process, and—like every other conversion process in this world, from a nuke to an air conditioner—it operates at efficiencies much less than 100 percent. So, when you hear someone talk about a compiler that generates code superior to that of assembly language, ask him if the compiler comes with a free perpetual-motion machine.

One difference between good and bad assembly language is the effective use of the rather limited architectural features of the 80X86. To achieve this goal, we select an efficient memory model and define a strategy for the use of registers.

The 80X86 architecture offers seven 16-bit general registers. Intel labels the stack pointer an "eighth" general register; it never is. Each of the seven general registers has one or more dedicated instructions that manipulate or access the register contents:

```
AX      cbw, lods, stos
BX      xlat
CX      loop
DX      mul, div, in, out, cwd
DI      stos
SI      lods
BP      enter, leave
```


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Because of these register-specific instructions, it is important to choose the correct register to hold a value so that when you manipulate the value, you can take advantage of the special instructions.

A most obvious example is a loop index. If you are going to do something *n* times, *n* is best kept in the CX register. This permits the use of the LOOP instruction, which is faster and more readable than its two-instruction equivalent:

```
        mov   ah,0          ; checksum record
        mov   cx,[si-2]     ;  (assume cx!=0)
chk1:   lodsb
        add   ah,al
        loop  chk1
```

The three kinds of data most commonly held in registers are numbers, characters, and addresses. Numbers can be 8, 16, or 32 bits (as in C). A number's signed or unsigned characteristic is not important for assembly language data except for relative comparisons. Because the 80*X*86 has 16-bit registers, that is the most common numeric data size.

An address pointer on the 80*X*86 consists of two 16-bit portions: a segment and an offset. Depending on the circumstances, it may be more convenient to think of an address as a full segment–offset pair or just as an offset. The full segment–offset specification is useful for pointers to dynamic storage. A lone offset suffices when the segment is known (such as DGROUP) or when indexing an offset with another pointer.

Indirect addressing is possible only from the four index registers (BP, BX, DI, SI), which dictates that these registers tend to carry addresses while the three remaining registers (AX, CX, DX) tend to carry numbers. In spite of the official Intel nomenclature, I often refer to the base registers BX and BP as *index registers;* don't be confused.

The closest thing I can offer as a systematic method for register assignment is to ask yourself what kind of quantity you are working with and try to find an approximate description below. Through experience, you gain an instinctive feel for the register set and know the optimal way to express algorithms.

Below are guidelines for register usage that work very well in my programs. By following these conventions, you may well find your programs shorter and more efficient. Remember, if the preferred register is not available and another register is free, use the free register.

- AX is for computation of all kinds of temporary values, including the least-significant half of a numeric dword. Character values rarely appear in registers other than AL or AH.
- AX is a favorite register for passing and returning numeric quantities from a subroutine; however, note the preferred use of CX and DX below.
- AX is not suitable for long-term storage across one or more subroutine calls, because subroutines often return a value in AX or neglect to preserve it.
- BX is the least useful of the index registers because, unlike the valuable features of DI, SI, and BP, BX's only claim to fame is an otherwise useless XLAT instruction. In a later column, I will introduce sophisticated techniques that use BX; for now, consider BX a general-purpose register.
- The LOOP instructions designate CX as the counting register, and I keep all kinds of counts in CX, even those inappropriate for LOOPing; as examples, a

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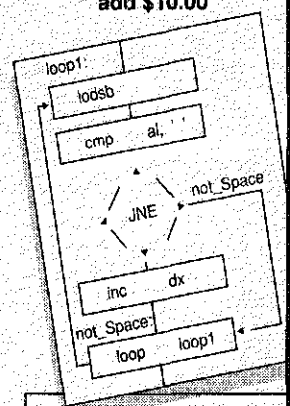

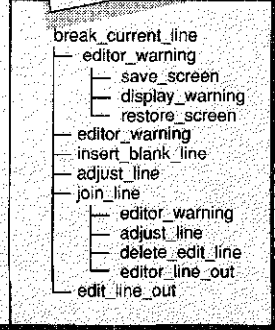

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memory-allocation routine accepts a byte count in CX, and the **strlen** function returns string length in CX.

- On rare occasions when manipulating a pair of 32-bit values, use DX AX as the primary register and BX CX as the secondary. Consistency is important: Always keep the most-significant words in DX and BX and the least-significant words in AX and CX.
- DX is good for general-purpose numeric storage, especially when calling subroutines that might bash AX. DX serves as the most-significant half of 32-bit numbers in DX AX.
- DX might also contain a separate count when CX is busy. For example, DX might count up the number of words in a string as CX counts down the number of characters left.
- Another use for DX is to point to the end of a buffer. While we cannot use DX as an index register, we can compare an index register such as SI or DI with DX. This is valuable when processing binary information, where end of data is not easily determined from the data itself.
- The primary purpose of DI is that of output pointer. The MOVS and STOS instructions that use DI are especially useful for "write-once-maybe-read-later" operations, such as writing to a display buffer or an output file.
- DI is also useful as a general-purpose index register, although not quite so useful as SI. On occasion, ES:DI will point to a static string, especially when DS:SI is not available, as might be the case in a search routine.

The Indispensible Quick Reference Guide for Assembly Language Programming

MASM QuickRef

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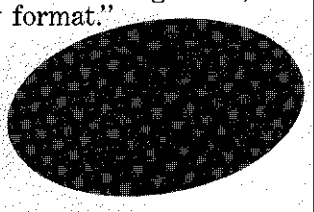

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- When not required for output or as an index register, DI is suitable for computing or holding numeric values. Avoid using DI to pass or return numeric values to procedures.
- It is easy to become confused about which segment register associates with DI. Depending upon the addressing mode, three different segment registers combine with DI to form an address. The MOVS and STOS instructions use ES; DI indexed alone or with BX uses DS; DI double-indexed with BP uses SS.

```
STOSW           ; uses ES
MOV AX,[DI]     ; uses DS
MOV AX,[BX+DI]  ; uses DS
MOV AX,[BP+DI]  ; uses SS
```

- Of the four index registers, SI is king. Whenever reading strings or other data, try to use SI as the pointer. The LODS and MOVS instructions make read access via SI particularly convenient and efficient.
- Because a program is almost always processing some sort of input data, SI is rarely used as a general-purpose register for numeric values.
- A very important characteristic of BP is its ability to address memory via the stack-segment, as opposed to the data-segment, register. High-level languages use this feature to access parameters and automatic variables on the stack. Although this is a useful feature, our primary use of BP is to access static variables and DGROUP.
- While making decisions on register assignments, spend more time designing register usage for the entry and exit conditions of subroutines than on the code sequences within a routine. A primary feature of subroutines is reusability, and the more often a program references a routine, the greater its influence on the program. Poorly designed entry and exit conditions degrade code around each call to the routine and can ripple through several logical layers. A poor selection within an isolated sequence of code affects only that section of code.
- If efficiency dictates use of a less-than-ideal register within the logic of a routine, use the ideal register in the entry/exit conditions and the necessary register within the logic of the routine. One or two move instructions is less of a penalty than poorly designed routine.

Assembler vs. *Assembly*

An article in the June issue of *Dr. Dobb's Journal* reminds me of an important piece of lexical knowledge for programmers: Assemblers assemble assembly language—assemblers do *not* assemble assembler. I'm referring to the misuse of the word *assembler*. A programmer programs "in assembly language," which one might shorten to "in assembly" but never "in assembler." Got it?

The article also inspires me to note an error of my own, one of omission. In my last column (*PJ* 7.4), I warned against the practice of commenting every line of code, because the excess comments often provide no additional information and obscure useful documentation. I neglected to write that use of too many remarks frequently results in comments that are out of date or incorrect. For example, on page 149 of the same issue of *DDJ*, the following code appears:

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```
; This is the loop that does the actual block
; blasting. Two counters are kept, and share CX by
; being separate values in CH and CL. After each
; line blast, both pointers are adjusted and the
; counters swapped, the LOOP counter decremented and
; tested and then the counters swapped again.
; ------------------------------------------------
MovEm:  MOV   CX,[bp].BWidth          ; Load atom
                                      ; counter in CH
        MOV   AH,BYTE PTR [BP].Attr ; Load attribute
                                      ; into AH
DoChar: LODSB         ; Load char from block storage
                      ; in AL
        STOSW         ; Store AX into ES:DI,
                      ; increment DI by 2
        LOOP  DoChar  ; Go back for next char if
                      ; CX > 0
```

The paragraph preceding the code is completely wrong, as is the comment on the first instruction. I read assembly language easily, yet I spent several minutes on this trivial section of code because of the confusing comments. Apparently, the programmer initially wrote and documented this section of code one way, changed the code, and forgot to update the comments.

In that last column, I also warned against documenting the obvious function of the code, and in the above fragment, every line contains some sort of obvious statement. The worst comment is "Store AX into ES:DI, increment DI by 2"—it restates what the STOSW instruction does and not what the programmer is trying to do with STOSW. Avoid the use of phrases such as "in CH" and "into AH", not only because this is obvious from the instruction, but should you change the register, you may fail to update the comment.

Below are two code snippets. The first is the rough C equivalent to the above example. If you believe the above code demonstrates good commenting conventions, surely this C code will change your mind. The second snippet demonstrates a more informative style for comments.

```
for(i=bwidth;i>0;i--) { /* load counter into i */
  c = *p++;    /* load c from block storage     */
  *q++ = c;    /* store c into *p, increment p  */
}              /* go back for next char if i>0  */
```

```
1$: mov   cx,BWidth[bp]     ; move text to display
                            ; memory
    mov   ah,bptr Attr[bp] ; use attribute from
                            ; parameter list
2$: lodsb
    stosw
    loop  2$
```

The "1$" and "2$" are OPTASM local labels, and "bptr" is an equate for the text "byte ptr". In future columns, I will cover optimization and defensive coding techniques for code sequences such as the above. Notice the potential problem with the logic in this code? (*Hint:* The C code does not suffer from it.)

MASM

Microsoft is rewriting MASM, and this time they are using a language specification. Longtime MASM users are familiar with the history of problems in this product: Source is neither upward nor backward compatible; examples in the manual do not work; bugs are documented rather than fixed (for a good laugh see page 136 of the 5.0 manual). Now, MASM has competition from OPTASM and TASM; Microsoft is concerned.

All versions of MASM through 5.1 are two-pass assemblers. "Two-pass" means that MASM looks at the source code twice during the assembly process. This is a classic design followed by most assemblers. During an initial pass, MASM parses each source line and guesses at the length of an instruction appearing on the line. MASM enters symbols found on the line into the symbol table and updates the location counter using the guessed line length. On the second pass, MASM reparses each line, and because all symbols are now defined, MASM can output the actual bytes for instructions and data.

Why does MASM generate extraneous NOPs and phase errors? The combination of a two-pass design, variable-length instructions, and uniform instruction mnemonics guarantees inefficient code generation, because MASM cannot know the correct length of all instructions on the first pass. Consider the jump instruction. Many processors offer two-byte and three-byte jump instructions. The Z80 does, but Z80 assemblers do not suffer from the NOP problem because Z80 assembly language assigns different instruction mnemonics to each flavor of jump (JR and JP). Thus, a Z80 assembler knows how long a jump instruction is on the first pass.

Intel's definition of assembly language defines JMP as the mnemonic for all classes of unconditional jumps. When the target of a jump is a forward reference and not yet defined, MASM cannot determine how long the instruction is and uses a guess of three bytes. If the guess is too long, MASM inserts a NOP; if the guess is too short, MASM generates a phase error.

So, MASM's two-pass approach to 80X86 assembly language is inadequate. What about TASM? Borland's assembler implements a one-pass assembly algorithm. The first pass performs much the same function as that in MASM, but TASM goes ahead and generates code for the instructions that are completely defined (those with no forward references).

TASM also builds a list of undefined instructions on the first pass. When the source is completely processed and the symbol table complete, TASM generates code for the instructions in that list. Unfortunately, TASM cannot change the length of an instruction and therefore has the same problem with NOPs and phase errors as MASM.

One might think Borland solved such problems with ideal mode. Wrong. Ideal mode simplifies the rather complex language syntax of MASM, resulting in programs that are easier to assemble. Who cares? I consider "rawdeal" mode an aberration; I intend to ignore this "feature."

The third member of this assembler trio is OPTASM, by SLR Systems. OPTASM implements what is known as an *n*-pass algorithm. The first pass is similar to that of a one-pass assembler except that OPTASM keeps enough information on each instruction so that on subsequent passes, should any instruction change size, OPTASM can make adjustments to appropriate instructions. OPTASM continues passes over the code until every instruction is of optimal length. Because instructions can shrink or grow, OPTASM never generates NOPs or phase errors. Even with the extra passes, OPTASM is significantly faster than either TASM or MASM.

Unfortunately for many users, reports are that the new version of MASM uses a one-pass design. Extraneous NOPs and phase errors will persist, and I find nothing new about that.

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BBS

As opposed to the problem MASM and TASM have with forward references, this column has a problem with backward references. What to do when missing important information from a previous column? *PJ* might suggest that you purchase the necessary back issues—a good idea, even though I don't receive residuals on back issues. Order the back issues (and maybe a T-shirt), and then have your computer call my bulletin board system and download files pertaining to this column. The phone number is 213-559-1449. The filename for any given column is PJ*xx*.ZIP, where *xx* is the two-digit number of the volume of *Programmer's Journal* in which the column appeared. For example, the filename for this issue is PJ75.ZIP.

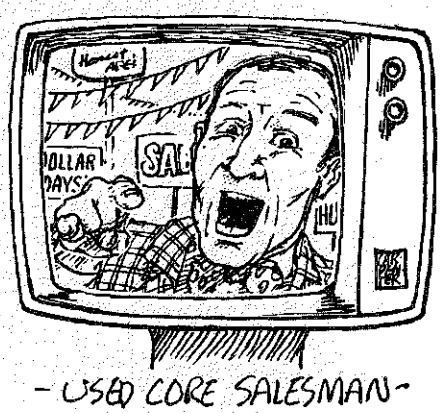
Phil Katz's shareware ZIP utility is required to unpack the component files from the archive. If you are unfamiliar with PKZIP, the self-extracting ZIP program is available from numerous sources. The most recent version is PKZ092.EXE.

That wraps up this column. Can you believe an assembly language column in which most of the listings are in C? My next column will have more information on the ideal model for assembly language, including a very efficient technique for static-variable access.

PJ

John Otken is the president of Soft Advances, where he develops debuggers for PCs and embedded systems applications. He may be reached at 10811 Washington Blvd., Suite 205, Culver City, CA 90232, 213-559-7105.

Code follows.



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```
resetprn.lst    ResetPRN v1.01              Sourcer Listing    28-Jun-89  2:34 pm      Page 1

                                PAGE  60,132
                                        RESETPRN

                                Created:   15-Apr-88
                                Version:   1.01
                                Passes:    3          Analysis Flags on: H

= 0008                          data_1e     equ     8               ; (0040:0008=378h)

                                ;--------------------------------------------------------- seg_a ----
                                seg_a       segment para public
                                            assume cs:seg_a, ds:seg_a, ss:stack_seg_b

                                resetprn    proc    far
658E:0000                       start:
658E:0000  EB 23                            jmp     short loc_1
658E:0002  52 65 73 65 74 50                db      'ResetPRN v1.01', 0Dh
658E:0008  52 4E 20 76 31 2E
658E:000E  30 31 0D
658E:0011  0040                 data_2      dw      40h
658E:0013  0D 0A 52 65 73 65    data_3      db      0Dh, 0Ah, 'Reset Printer? $'
658E:0019  74 20 50 72 69 6E
658E:001F  74 65 72 3F 20 24
658E:0025
658E:0025                       loc_1:
658E:0025  0E                               push    cs
658E:0026  1F                               pop     ds
658E:0027  BA 0013                          mov     dx,offset data_3  ; (658E:0013=0Dh)
658E:002A  B4 09                            mov     ah,9
658E:002C  CD 21                            int     21h               ; DOS Services  ah=function 09h
                                                                      ;  display char string at ds:dx
658E:002E  B4 01                            mov     ah,1
658E:0030  CD 21                            int     21h               ; DOS Services  ah=function 01h
                                                                      ;  get keybd char al, with echo
658E:0032  3C 79                            cmp     al,79h            ; 'y'
658E:0034  75 18                            jne     loc_3             ; Jump if not equal
658E:0036  8E 1E 0011                       mov     ds,data_2         ; (658E:0011=40h)
658E:003A  8B 16 0008                       mov     dx,ds:data_1e     ; (0040:0008=378h)
658E:003E  83 C2 02                         add     dx,2
658E:0041  B0 08                            mov     al,8
658E:0043  EE                               out     dx,al             ; port 37Ah, printer-2 control
                                                                      ;  al = 8, initialize printer
658E:0044  B9 8000                          mov     cx,8000h
658E:0047                       locloop_2:
658E:0047  E2 FE                            loop    locloop_2         ; Loop if cx > 0
658E:0049  B0 0C                            mov     al,0Ch
658E:004B  EE                               out     dx,al             ; port 37Ah, printer-2 control
                                                                      ;  al = 0Ch, init & strobe off
658E:004C                       loc_3:
658E:004C  B4 4C                            mov     ah,4Ch            ; 'L'
658E:004E  CD 21                            int     21h               ; DOS Services  ah=function 4Ch
                                                                      ;  terminate with al=return code
                                resetprn    endp
                                seg_a       ends

                                ;--------------------------------------------------------- stack_seg_b ----
                                stack_seg_b segment para stack
6593:0000  00C0[FF]                         db      192 dup (0FFh)
                                stack_seg_b ends

                                            end     start
```

(Source code output and inline cross reference can also be selected)

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Mail-order information on pages 8 and 88.

Code from "A Library System for Assembly," by John Otken

1

LISTING 1

```
/* libgen - generate miscellaneous control files for building library

    usage: libgen *.asm

    Borland   C>tcc libgen.c wildargs.obj
    Microsoft C>cl  libgen.c setargv.obj

    You may have to specify correct path information for the
    wildargs and setargv obj files.

    John Otken, Soft Advances
*/

#include <stdio.h>

/* prototypes begin */
sort(char *(*v)[], int n);
/* prototypes end */

void main(int argc, char *argv[])
{
    char *pt;
    FILE *arf, *mak, *opt;
    int i;

    if (argc < 3) {
        printf("usage: libgen *.asm\n");
        exit(0);
    }

    arf = fopen("lib.arf", "w");
    if (!arf) {
        printf("Error opening lib.arf file\n");
        exit(1);
    }

    mak = fopen("lib.mak", "w");
    if (!mak) {
        printf("Error opening lib.mak file\n");
        exit(1);
    }

    opt = fopen("lib.opt", "w");
    if (!opt) {
        printf("Error opening lib.opt file\n");
        exit(1);
    }

    sort(&argv[1], argc-1);

    fprintf(arf, "lib.lib\ny\n");

    for( i = 1; i < argc; i++) {                    /* for each argument */
        pt = argv[i];                                /* change x.asm to x */
        for( ; *pt != '.' && *pt != '\0'; pt++);
        *pt = '\0';

        pt = argv[i];                                /*  write response file */
        fprintf(arf, "+%s &\n", pt);                 /*  & make file entries */
        fprintf(mak,"%s.obj:\t%s.asm lib.equ\n\tmasm %s/t/z;\n\n",pt,pt,pt);
        fprintf(opt," lib.lib %s.asm lib.equ\n-%s /t/z/i \\asm ;\n",pt,pt,pt);
    }

    fprintf(arf, "\nNUL\n");

/*  fprintf(mak, "lib.xxx:\tlib.lib\n\tdelete lib.lib\n\tlib @lib.arf\n"); */
    fclose(arf);
    fclose(mak);
    fclose(opt);
}

sort(char *(*v)[], int n)                    /* sorts pointer array to char */
{
    char *temp;
    int gap, i, j, k;

    for (gap = n/2; gap > 0; gap /= 2)
        for (i = gap; i <n; i++)
            for (j = i-gap; j >= 0; j -= gap) {
                k = j + gap;
                if (strcmp((*v)[j], (*v)[k]) <= 0)
                    break;
                temp = (*v)[j];
                (*v)[j] = (*v)[k];
                (*v)[k] = temp;
            }
}
```

2

LISTING 2

```
/*  asmhdr - process assembly language headers

    usage:  asmhdr document_file *.asm

    Borland   C>tcc -mc asmhdr.c wildargs.obj

    You may have to specify correct path information
    for the wildargs obj files.  Compile with compact
    memory model.  This program was written for Turbo
    C but it would be easy to modify for Microsoft C.

    John Otken, Soft Advances
*/

#include <alloc.h>      /* use malloc.h for microsoft c */
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define LINE_SIZE       256
#define MAX_ROUTINES    1000    /* maximum routines */
#define READ_TEXT       "rt"
#define WRITE_TEXT      "wt"


/* prototypes begin */
void process_asm_file(char *fn);
void out_of_memory(void);
int stricmp_pt(struct index_tag *a, struct index_tag *b);
/* prototypes end */


struct index_tag {
    char *routine_name;
    char *routine_header;
} index[MAX_ROUTINES];


int index_cnt = 0;              /* number of index entries */
unsigned long coreused = 0;     /* total storage used */


void main(int argc, char *argv[])
{
    int i;
    FILE *fo;
```

Code continues . . .

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Otken code, continued

3

```
    if (argc < 3) {
        printf("asmhdr outfile *.asm");
        exit(0);
    }

    i = 1;
    fo = fopen(argv[i], READ_TEXT);
    if (fo != NULL) {
        printf("Error: %s exists!  Overwriting source file?\n", argv[i]);
        fclose(fo);
        exit(1);
    }

    fo = fopen(argv[i], WRITE_TEXT);
    if (fo == NULL) {
        printf("Error opening output file: %s\n", argv[i]);
        exit(1);
    }

    for(i = 2; i < argc; i++)
        process_asm_file(argv[i]);

    qsort(&index[0], index_cnt, sizeof(index[0]), stricmp_pt);

    for(i = 0; i < index_cnt; i++)
        fprintf(fo,"%s\n",index[i].routine_header);
    fclose(fo);

    printf("Used %d of %d index entries.\n", index_cnt, MAX_ROUTINES);
    printf("Used %lu bytes.\n", coreused);
                /* microsoft c does not have a coreleft function */
    printf("%lu free bytes.\n", (unsigned long) coreleft());
}



void process_asm_file(char *fn)
{
    char *p, *q;

    char line[LINE_SIZE],    /* file line buffer */
         buf[3000];          /* temp buffer */

    FILE *fi;

    fi = fopen(fn, READ_TEXT);
    if (fi == NULL) {
        printf("Error opening input file: %s\n", fn);
        exit(1);
    }

    while (fgets(line, LINE_SIZE, fi) != NULL) {
        if (line[0] == ';'  &&  line[1] == ';'  &&  line[2] == '\t') {

            p = buf;
            do {
                p = stpcpy(p, line);
            } while (fgets(line, LINE_SIZE, fi) != NULL  &&  line[0] == ';');
            if (*(p-1) == '\n'  &&  *(p-2) == ';')  p -= 2;
            *p = '\0';
            if ((index[index_cnt].routine_header = strdup(buf)) == NULL)
                out_of_memory();
            coreused += strlen(buf)+1;

            p = &buf[3];         /* extract routine name from header */
            q = buf;
            while (*p != '\n') {
                if (*p == ' ')  *p = '_';
                *q++ = *p++;
            }
            *q = '\0';

            if ((index[index_cnt++].routine_name = strdup(buf)) == NULL)
                out_of_memory();
```

4

```
            coreused += strlen(buf)+1;
        }
    }
    fclose(fi);
}



void out_of_memory(void)
{
    printf("Out of memory");
    exit(1);
}



int stricmp_pt(struct index_tag *a, struct index_tag *b)
{
    return stricmp(a->routine_name, b->routine_name);
}
```

LISTING 3

```
        title   outchr
        .model  small
        .code
        extrn   ms_dos:near
        public  outchr

;;      outchr
;
;       entry   AL      char
;       uses    AX
;
outchr  proc
        push    ax
        push    dx
        mov     ah,2
        mov     dl,al
        call    ms_dos
        pop     dx
        pop     ax
        ret
outchr  endp

            end
```

LISTING 4

```
        title   ms_dos
        .model  small
        .code
        public  ms_dos

;;      ms_dos
;
;       note    entry/exit conditions defined
;               in dos technical reference
;
ms_dos  proc
        int     21h
        ret
ms_dos  endp

            end
```


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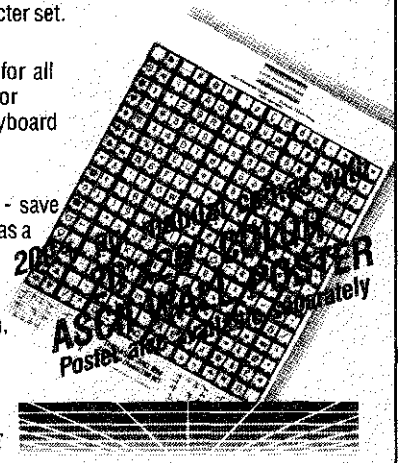

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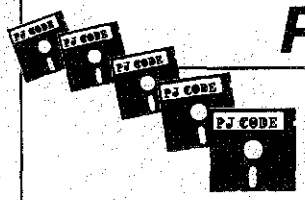

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The World in Your Hands

by
Gene Fowler

Turbo Pascal 5.0's graphics primitives are a first-rate tool . . . but there's no world for scaling or 3-D. With GRAPHWLD.TPU, that changes.

GRAPHWLD.TPU isn't a "shell" or "interface" creating the illusion that you are working with a kernel like that in Graphix Toolbox but with BGI's stroked fonts and surface fills inside. It holds the same primitives or raw building blocks that BGI supplies in GRAPH.TPU, but with add-on "**wld2vport**" translators wrapped around each.

The names of these "parallel" drawing primitives identify the "originals" they call. If you are working in a world and would call **Line(vpx1,vpy1,vpx2,vpy2)**, you instead call **WLine(wx1,wy1,wx2,wy2)**, and **WLine** translates the world coords to viewport coords and calls **Line(vpx1,vpy1, vpx2,vpy2)**.

Inventory

The world-handling primitives in the unit are **WPutPixel** and **WGetPixel**; **WLine**, **WLineTo**, and **WLineRel**; and **WMoveTo** and **WMoveRel**. Three stand-alone translators allow you to translate coordinates (**w2vp**), distances or relative coordinates (**w2vpRel**), and radius lengths (**w2vpRadius**).

In some instances, you can translate a set of display coordinates once, hang on to the *vp* values, and use them in repeated calls. In other instances, you will use procedures from GRAPH.TPU involving a number of params that a "parallel" package would have to take time to relay. In the following example, **w2vp** is used to translate a pair of world coordinates into viewport coordinates to place text in the world picture plane using **OutTextXY**:

```
SetTextstyle(DefaultFont,HorizDir,1);
wx := 200; wy := 250;
w2vp(wx,wy,vpx,vpy); (uses stand-alone translator)
OutTextXY(vpx,vpy,'press any key...')
```

We need a *vpx* and a *vpy* for **OutTextXY**. A package would have to relay the text through a parameter and a stuff-in inside. It's quicker, then, to use the stand-alone **w2vp** and call **OutTextXY** from the program.

In the following example, you see a use for **w2vpRadius**:

```
wt1 := (MaxWX + 1) shr 1; {wx for center point}
wt2 := (MaxWY + 1) shr 1; {wy for center point}
w2vp(wt1,wt2,vpt1,vpt2);
wRadius := 50; wAspRatio := 0.44;
w2vpRadius(wRadius, vpRadius,wAspRatio;
circle(vpt1,vpt2,vpRadius);
```

Here, **w2vpRadius** takes VAR params *wRadius* and *vpRadius* and translates. It takes *wAspRatio* value. (Demos to run on all cards are in 640:200 world.) To call Circle, you must give the coordinates of the center and a radius length. To draw in your world, use **w2vpRadius** to translate. You need VAR params *wRadius* and *vpRadius*, and you must supply the world's aspect ratio (not the screen's) in the VALUE param *wAspRatio*.

"Birthing" a World

The inventoried primitives won't work if you haven't created a world for them to work in. GRAPHWLD.TPU's main procedure, therefore, is **CreateWorld(ULx,ULy,LRx,LRy)**. The params are the minimum and maximum *x* and *y* world values, not the viewport values. **CreateWorld** sets up all the reference values for doing the translations and some other related references for the procedures inventoried above to use.

In TP5.0 BGI, all coordinates are viewport relative; so, it is *very* important that you set your viewport *before* you call **CreateWorld**. And if you set a new viewport and are going to use the same world (for scaling), you must repeat your **CreateWorld**, because **CreateWorld** uses the viewport information to set up for translation.

Doing a Cartesian Flip

You can flip your world "upside down" to have the Cartesian coordinate field used in science and business. This is a *y*-axis flip, and you accomplish it by having *ULy* > *LRy*. In **CreateWorld**, these will be reversed, and translation will treat of a "right-side-up" world; then, at the end, the *vpy* will be set at the distance from the lower screen edge that it was from the higher screen edge. The trigger for this is the *ULy* > *LRy*.

A Demo Worth Doing

If you are, like me, a "gentleperson amateur" or even (and it happens) a "Sunday programmer," you'll have fun with this demo.

I've bypassed the expected demo that sets up a world "differently proportioned" than your usual viewport world to show off my procedures and the power to scale. I'm going to step off into a wonderful three-dimensional world for rotating and moving about "solid" geometrical objects.

GRWDEMO.PAS is definitely "stripped down." For starters, there's no error handling; so type carefully. The object is a cube—or it *was*, for only two faces remain. A single face was difficult to see as rotating rather than distorting.

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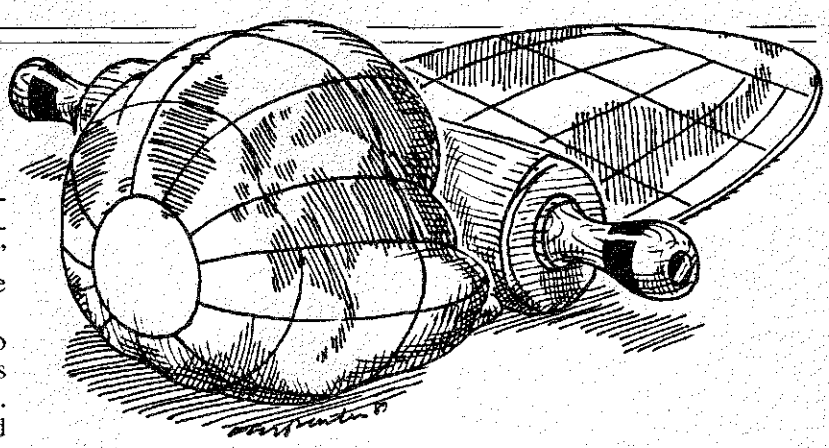


There is no hidden surface marking and no surface filling, and so you have a "wire frame" figure. There's no flag system to avoid "double" drawing of lines; I just leave off one line on one of the surfaces.

When you run the program, you get an intro screen that tells you what's going on and asks for three rotation params for yaw, roll, and pitch. You must enter each in degrees (0–360), and there's no error prevention or handling. The program converts to radians for the math. You don't enter translations, picture-plane distance, object distance, or other params. Check in **InitWorld** to find those things, and add them to the data entry (**GetParams**) if you wish. As you enter the third param, the program draws the figure (see the illustration). Press a key, and you can repeat or quit. You can, of course, write in code to have the repeats "adjust" angles. As it is, you must enter your three params again.

It's crude, but the "how to" of 3-D object handling is clearly set out. Start reading the main program, and go look at the procedures in the order they're called. It will read clearly—the strength of Pascal identifiers.

Finagling a World

Engineering texts stretch my faculties a bit painfully; so, I extracted the maths from Lee Adams' *High-Performance Interactive Graphics (for IBM PCs and Compatibles)* (Tab Books, 1987). And a recommended world for 3-D graphics came along with the maths.

It's a 4:3 world, or, in units, 800:600. You'd enter that (in **InitWorld**):

```
CreateWorld(-399,-299,400,300)
```

Note the negative (minimum) coordinates—"-1" because the 0,0 coordinates specify one of the 800x600 locations. This is the world I've typed into GRWDEMO.PAS as it's printed.

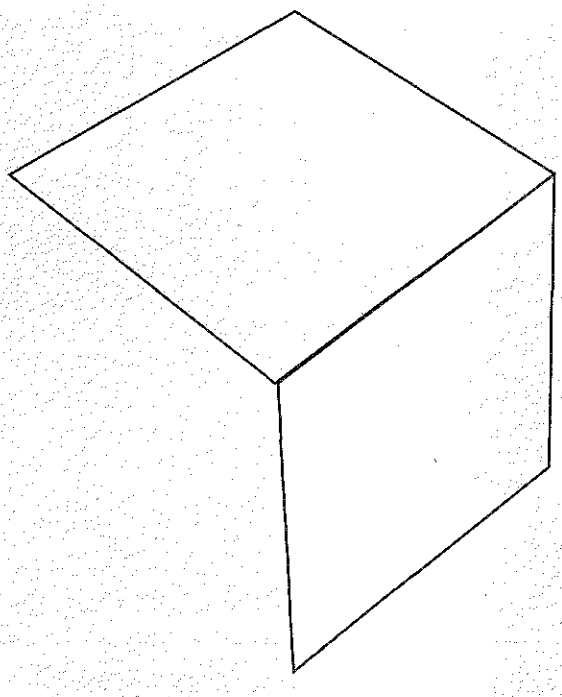
Adams gets this "aspect ratio" (built into the world) from the display space on most personal computer monitors and all TV monitors. Most discussions of aspect ratio have to do with pixel shape, not display-area shape. This presented no problems to Adams, but it will to us. Adams assumed CGA, EGA, VGA, PCjr system, a Tandy clone to the latter, and the monitors attached to those. But more important, he assumed programming in the BASICA interpreter and equivalents. He mentions BASICA's card "drivers," and my guess is that those drivers, for those cards, take care of the pixel-shape aspect ratios. And monitors attached to them have 4:3 display areas.

My HGC+–driven 1985 IBM monochrome monitor did not give me squares "on the picture plane" in this 4:3 world, and so I had to finagle a workable world. Not only that, but when I decided to fire up my **GraphPrt** and hardcopy my screen (not viewport), I had to finagle a different world to get the squares on paper instead of on screen.

I have an 800:550 world for my screen and an 800:640 for my screen2printer. Those are "plastic ruler"–calibrated squares. I've been unable to find any functional relation between that extra "contraction" (and later overcompensating "expansion") and the 3:2 (9-inch-by-6-inch) display space on my monitor, the pixel-shape aspect ratio of 0.75 BGI assigns to the HGC, or the 0.725 that works better on my monitor. So I can't give you a nice **GetAspectRatio**-fed way to compute your "finagle." But I have set up GRWDEMO to make finagling a world pretty easy.

Run GRWDEMO in the IDE. Put the cursor on the **CreateWorld** line in **InitWorld** and (since you'll be adjusting both each time) on one of the two *y* coordinates.

Ctrl-F9 runs it. Enter three zeros. It'll draw one of the faces on the picture plane, with the other bent back at 90 degrees. Apply a stiff ruler (the screen may be curved) and measure. Press any key and then Q (for "quit") to return to code. Adjust the pair of *y* coordinates. If your "square" was too tall, decrement the *y* coordinates; if it was too flat, increment them. A few run-throughs and you should have your world.



Printout of a GRWDemo screen with 45-degree yaw, 0-degree roll, and -45-degree pitch. With other angles, you might see a tangle of wire framings, an incentive to "blank" the faces as you draw them.

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And "Flipping" a World

When you have *your* world in the **CreateWorld** line, look at the commented-out **CreateWorld** line below it: It has the y coordinates reversed. Comment out the world you've been using and remove the commenters from this one, run the program, enter your same three zeros, and see what happens to the drawing and text.

Nailing Together an Object

You can use what I've set out as GRWDEMO as a kind of "testbed" or "breadboard" and build up whatever piece of furniture you'd like, learning how it works by having built it. For instance, you can go into **ConstructModel** and "weld on" the other four faces of the cube.

First, of course, you've got to go into **InitWorld** and add two vertices to **WObj**. That means you have to go up to your types and get all those arrays expanded to hold those additional coordinate sets. And you'll have to go where view and display coordinates are calculated and check loop counts so that they all get done. And later, when you sheepishly go back and find one more loop or declaration (thanking your stars for TP5's integrated debugger), you'll figure you've learned something about all this.

Then, in **ConstructModel**, you can fake up those sides like I did my second one. Just draw lines not already drawn when you add a face. You'll get your cube quick and easy. And that's fine for wire frame. Later, you'll want to do solid objects or engineer's X-ray (with special line style). At that time, you're going to have to bring in the "hidden surface" calculation to know what kind of lines to draw for a given face on your rotated cube. When you're ready for that, I recommend Appendix B in Adams' book. Even before that, you can change the way you draw your wire-frame cube to get ready for the more sophisticated handling.

You will need a stack of flags for the twelve lines so that a set flag says, "Draw this line." Then, you have a single figure drawing chunk of code. Each face handler sets the flags of those lines it requires. In your wire frame, each flag gets set, twice; there is a face on each side of a line.

Later, when you are set to do X-ray and solid figures, you will have two stacks of flags—one for the full lines for the "visible" surfaces and one for the "invisible" surfaces (controlling the drawing of dashed or unseen lines). Draw the full lines first, and when drawing a full line, turn off the corresponding dashed or empty line in the other stack.

When you begin reshaping the code into that sort of "designed" elegance, you leave the realm of hacking results onto the screen for the software engineer's workshop. But I'll tell you, I've been poking around in here (as you can see), and I haven't yet run into a "No Trespassing" sign or a locked cabinet, and nobody's glared at me. And I'm having a ball. So now you understand why the demo wasn't a quiet little testbed where I could run through the GRAPHWLD procedures one by one. PJ

With credentials only as outlaw poet, Gene Fowler enters computing as a "gentleperson amateur" programmer with a philosophy of "jump in and work out a way to do it before coming across documentation that it's not possible." You can write Gene by non–e-mail at 1432 Spruce Street, Berkeley, CA 94709.

Code follows.

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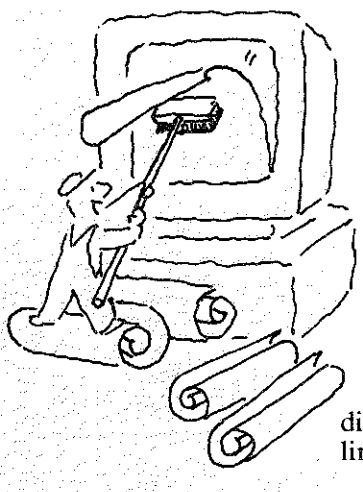

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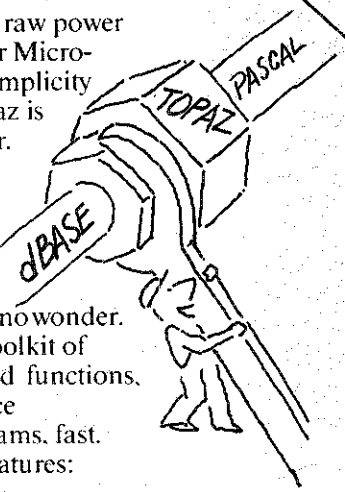

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Code from "The World in Your Hands," by Gene Fowler

1

LISTING 1

```
{GraphWld.tpu Copyright (C) 1989 by Gene Fowler

GraphWld.tpu extends Graph.tpu to handle world co-
ordinates by providing parallel drawing procedures
that translate world to viewpoint coordinates and
call the original procedures from Graph. There are
also two stand-alone translators (one for x,y co-
ordinates and one for dx,dy relative coordinates
or distances) when one translation yields variables
for repeated calls or a parallel procedure would
have to relay extra params.

The "central" procedure is CreateWorld(ULx,ULr,LRx,
LRy). The params define your world. This procedure
is called AFTER any defining of a viewport in which
the world will exist and BEFORE any use of the
translating procedures.
}
unit GraphWld; {world coordinates ext. to Graph.tpu}

interface

uses crt, graph;

procedure CreateWorld(ULx, ULy, LRx, LRy : real);

procedure w2vp(Var wx, wy : real; var vpx, vpy : integer);

procedure w2vpRel(Var wdx, wdy : real; var vpdx, vpdy : integer);

Procedure w2vpRadius(var wRadius: real; var vpRadius: word; wAspRatio: real);

procedure WPutPixel(wx, wy : real);

function  WGetPixel(wx, wy : real) : word;

procedure WLine(wx1, wy1, wx2, wy2 : real);

procedure WRectangle(wx1, wy1, wx2, wy2 : real);

procedure WLineTo(wx, wy : real);

procedure WMoveTo(wx, wy : real);

procedure WLineRel(wdx, wdy : real);

procedure WMoveRel(wdx, wdy : real);

implementation

var
   xv,yv, x1v,y1v,x2v,y2v : integer;
   MaxColor : word;
   RatioX, RatioY : real;
   VPMaxX, VPMaxY : integer;
   ViewP : ViewPortType;
   WXTotal, WXNegAdj, WYTotal, WYNegAdj,
   FTemp : real;
   FlipYFlag : boolean;
   ivpdx, ivpdy : real;
   xAsp, yAsp   : word;
   vpAspRatio : real;

procedure CreateWorld{(ULx, ULy, LRx, LRy : real)};

begin
   GetViewSettings(ViewP);  {Viewport must be set before world}
   with ViewP do
     begin
```

2

```
       VPMaxX := x2-x1;
       VPMaxY := y2-y1;
     end;
   if ULy > LRy then  { for Cartesian flip; corresponding vpy adjust. in
                        the procedures. }
     begin
       FlipYFlag  := true;
       FTemp      := ULy;
       ULy        := LRy;
       LRy        := FTemp;
     end
   else FlipYFlag := false;
   WXTotal := LRx - ULx + 1;
   if ULx < 0 then WXNegAdj  := Abs(ULx) else WXNegAdj := 0;
   WYTotal := abs(LRy - ULy) + 1;
   if ULy < 0 then WYNegAdj  := Abs(ULy) else WYNegAdj := 0;
end;

procedure w2vp{(Var wx, wy : real; var vpx, vpy : integer)};

begin
   RatioX := (VPMaxX + 1) / WXTotal; Ratio Y := (VPMaxY + 1) / WYTotal;
   wx := wx + WXNegAdj;
   wy := wy + WYNegAdj;
   vpx := round(wx * RatioX); vpy := round(wy * RatioY);
   if FlipFlag then vpy := VPMaxY - vpy;
end;

procedure w2vpRel{(Var wdx, wdy : real; var vpdx, vpdy : integer)};

var
   NFlagX : boolean;
   NFlagY : boolean;

begin
   RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
   if wdx < 0 then NFlagX := True else NFlagX := False;
   if not FlipYFlag then
     if wdy < 0 then NFlagY := True else NFlagY := False;
   else
     if wdy < 0 then NFlagY := False else NFlagY := True;
   wdx := abs(wdx); wdy := abs(wdy);
   vpdx := round(wdx * RatioX); vpdy := round(wdy * RatioY);
   if NFlagX then vpdx := -vpdx;
   if NFlagY then vpdy := -vpdy;
end;

Procedure w2vpRadius{(var wRadius: real; var vpRadius: word; wAspRatio: real)};

var
   wdx, wdy : real;

begin
   RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
   wdx    := sqrt(sqr(wRadius) / (1 + (sqr(wAspRatio))));
   wdy    := wAspRatio * wdx;
   ivpdx  := (wdx * RatioX);
   GetAspectRatio(xAsp, yAsp);
   vpAspRatio := xAsp / yAsp;
   ivpdy := (wdy * RatioY) * (wAspRatio / vpAspRatio);
   vpRadius := round(sqrt(sqr(ivpdx) + sqr(ivpdy)));
end;

procedure WPutPixel{(wx, wy : real)};

begin

   wx := wx + WXNegAdj;
   wy := wy + WYNegAdj;
   RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
   xv := round(wx * RatioX); yv := round(wy * RatioY);
   if FlipYFlag then yv := VPMaxY - yv;
   MaxColor := GetMaxColor;
   PutPixel(xv, yv, MaxColor);
end;

function WGetPixel{(wx, wy : real) : word};
```


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```
begin
  wx := wx + WXNegAdj;
  wy := wy + WYNegAdj;
  RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
  xv := round(wx * RatioX); yv := round(wy * RatioY);
  if FlipYFlag then yv := VPMaxY - yv;
  WGetPixel := GetPixel(xv, yv);
end;

procedure WLine(wx1, wy1, wx2, wy2 : real));

begin
  RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
  wx1 := wx1 + WXNegAdj;
  wy1 := wy1 + WYNegAdj;
  wx2 := wx2 + WXNegAdj;
  wy2 := wy2 + WYNegAdj;
  x1v := round(wx1 * RatioX); y1v := round(wy1 * RatioY);
  x2v := round(wx2 * RatioX); y2v := round(wy2 * RatioY);
  if FlipYFlag then
    begin
      y1v := VPMaxY - y1v;
      y2v := VPMaxY - y2v;
    end;
  Line(x1v,y1v,x2v,y2v);
end; {WLine}

procedure WRectangle(wx1, wy1, wx2, wy2 : real));

begin
  RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
  wx1 := wx1 + WXNegAdj;
  wy1 := wy1 + WYNegAdj;
  wx2 := wx2 + WXNegAdj;
  wy2 := wy2 + WYNegAdj;
  x1v := round(wx1 * RatioX); y1v := round(wy1 * RatioY);
  x2v := round(wx2 * RatioX); y2v := round(wy2 * RatioY);
  if FlipYFlag then
    begin
      y1v := VPMaxY - y1v;
      y2v := VPMaxY - y2v;
    end;
  Rectangle(x1v,y1v,x2v,y2v);
end; {WRectangle}

procedure WLineTo(wx, wy : real));

begin
  RatioX := (VPMax + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
  wx := wx + WXNegAdj;
  wy := wy + WYNegAdj;
  xv := round(wx * RatioX); yv := round(wy * RatioY);
  if FlipYFlag then yv := VPMaxY - yv;
  LineTo(xv,yv);
end; {WLineTo}

procedure WMoveTo(wx, wy : real));

begin
  RatioX := (VPMaxX + 1) / WXTotal; Ratio Y := (VPMaxY + 1) / WYTotal;
  wx := wx + WXNegAdj;
  wy := wy + WYNegAdj;
  xv := round(wx * RatioX); yv := round(wy * RatioY);
  if FlipYFlag then yv := VPMaxY - yv;
  MoveTo(xv,yv);
end; {WMoveTo}

procedure WLineRel(wdx, wdy : real));

var
  NFlagX : boolean;
  NFlagY : boolean;

begin
  RatioX := (VPMaxX + 1) / WXTotal; Ratio Y := (VPMax + 1) / WYTotal;
  if wdx < 0 then NFlagX := True else NFlagX := False;
  if not FlipYFlag then
    if wdy < 0 then NFlagY := True else NFlagY := False
```

Code continues . . .

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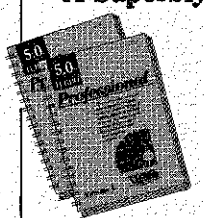

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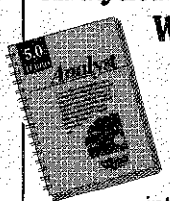

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Fowler code, continued

4

```
    else
      if wdy < 0 then NFlagY := False else NFlagY := True;
    wdx := abs(wdx); wdy := abs(wdy);
    xv := round(wdx * RatioX); yv := round(wdy * RatioY);
    if NFlagX then xv := -xv;
    if NFlagY then yv := -yv;
    LineRel(xv,yv);
end;  {WLineRel}

procedure WMoveRel{(wdx, wdy : real)};

var
    NFlagX : boolean;
    NFlagY : boolean;

begin
    RatioX := (VPMaxX + 1) / WXTotal; RatioY := (VPMaxY + 1) / WYTotal;
    if wdx < 0 then NFlagX := True else NFlagX := False;
    if not FlipYFlag then
      if wdy < 0 then NFlagY := True else NFlagY := False;
    else
      if wdy < 0 then NFlagY := False else NFlagY := True;
    wdx := abs(wdx); wdy := abs(wdy);
    xv := round(wdx * RatioX); yv := round(wdy * RatioY);
    if NFlagX then xv := -xv;
    if NFlagY then yv := -yv;
    MoveRel(xv,yv);
end;  {WMoveRel}

end.
```

LISTING 2

```
{GRWDEMO.PAS Copyright (C) 1989 by Gene Fowler
GRWDemo.pas is a stripped-down 3-D object
rotator and translator to be compiled in Turbo
Pascal 5.0 using crt, graph, and graphWld. It
uses three GraphWld procedures: CreateWorld in
InitWorld; WLine in ConstructModel; and w2vp
in WritePressKey.
}
program GraphWldDemo;

uses crt, graph, graphwld;

type
    ObjectVertex = record
                     x, y, z : real
                   end;
    WorldObj     = Array[0..5] of ObjectVertex;     {world coords}
    ViewObj      = Array[0..5] of ObjectVertex;     {view coords }
    ScreenVertex = record
                     sx, sy : Real
                   end;
    DisplayObj   = Array[0..5] of ScreenVertex;     {display coords}

var
    {BGI Init and other control variables}
    gdriver, gmode, ecode : integer;
    MaxX, MaxY : integer;
    MaxColor : word;
    ViewP : ViewPortType;
    GoAgain : char;

    {The Array variables}
    WObj   : WorldObj;
    VObj   : ViewObj;
    DObj   : DisplayObj;

    {3-D drawing variables}
    Dist : Real;
    YawDeg, RollDeg, PitchDeg,
    YawRad, RollRad, PitchRad,
    SinYawRad, CosYawRad, SinRollRad,
    CosRollRad, SinPitchRad, CosPitchRad,
    TransX, TransY, TransZ : Real;
```

5

```
    {work variables for calculations}
    x, y, z, xa, ya, za,
    x1, x2, x3, x4, y1, y2, y3, y4,
    z1, z2, z3, z4,
    sx, sy : Real;
    i : byte;

    {VAR params for the w2vp translation procedure in GraphWld.tpu}
    wx, wy   : real;
    vpx, vpy : integer;

procedure AdjustParams;   {for use in rotation calcs}
begin
    SinYawRad := Sin(YawRad); CosYawRad := Cos(YawRad);
    SinRollRad := Sin(RollRad); CosRollRad := Cos(RollRad);
    SinPitchRad := Sin(PitchRad); CosPitchRad := Cos(PitchRad)
end;

procedure CalcVandDArrays;
begin
    For i := 0 to 5 do
      begin
        x  := WObj[i].x; y := WObj[i].y; z := WObj[i].z;
        x  := (-1)*x;
        xa := CosYawRad*x - SinYawRad*z;
        za := SinYawRad*x + CosYawRad*z;
        x  := CosRollRad*xa + SinRollRad*y;
        ya := CosRollRad*y - SinRollRad*xa;
        z  := CosPitchRad*za - SinPitchRad*ya;
        y  := SinPitchRad*za + CosPitchRad*ya;
        x  := x + TransX; y := y + TransY; z := z + TransZ;
        sx := Dist*x/z; sy := Dist*y/z;
        VObj[i].x := x; VObj[i].y := y; VObj[i].z := z;
        DObj[i].sx := sx; DObj[i].sy := sy
      end
end;

procedure ConstructModel;

begin
    CalcVandDArrays;
    SetColor(MaxColor);
    SetLineStyle(0,0,1);

    {Surface 0 }
    x1 := DObj[0].sx; y1 := DObj[0].sy; x2 := DObj[1].sx; y2 := DObj[1].sy;
    x3 := DObj[2].sx; y3 := DObj[2].sy; x4 := DObj[3].sx; y4 := DObj[3].sy;
    WLine(x1,y1,x2,y2);  {In GraphWld: translates params, calls Line}
    WLine(x2,y2,x3,y3);
    WLine(x3,y3,x4,y4);
    WLine(x4,y4,x1,y1);

    {Surface 1}
    x1 := DObj[1].sx; y1 := DObj[1].sy; x2 := DObj[4].sx; y2 := DObj[4].sy;
    x3 := DObj[5].sx; y3 := DObj[5].sy; x4 := DObj[2].sx; y4 := DObj[2].sy;
    WLine(x1,y1,x2,y2);  {In GraphWld: translates params, calls Line}
    WLine(x2,y2,x3,y3);
    WLine(x3,y3,x4,y4);  {Note: don't REDRAW a line to close surface}
end; {ConstructModel}

procedure WritePressKey;
begin
    SetTextstyle(DefaultFont,HorizDir,1);
    wx := 200; wy := 250;
    w2vp(wx,wy,vpx,vpy);                    {uses stand-alone translator}
    OutTextXY(vpx,vpy,'press any key...')
end;

function Deg2Rad(Degs : Real) : Real;
begin
    Deg2Rad := Degs * 0.01745327778
end;

procedure InitWorld;  {also inits graphics, program}
begin
    gdriver := Detect;
    InitGraph(gdriver, gmode,'a:\');
```


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```
  ecode := GraphResult;
  if ecode <> 0 then
    begin
      writeln('Halted on graphics error: ', GraphErrorMsg(ecode));
        Halt(2)
      end;
    SetGraphMode(GetGraphMode);
    MaxColor := GetMaxColor;
    MaxX := GetMaxX;
    MaxY := GetMaxY;
    SetViewPort(0,0,MaxX,MaxY,ClipOn);
    {See Note in header about 'flagling' your world!}
    CreateWorld(-399.0,-299.0,400.0,300.0); {after setting viewport}
  (* CreateWorld(-399.0,300.0,400.0,-299.0); {"flipped" world}  *)

    {---Initialize DataBase---}
    WObj[0].x := 30; WObj[0].y := -30; WObj[0].z := 0;
    WObj[1].x := 30; WObj[1].y := 30; WObj[1].z := 0;
    WObj[2].x := -30; WObj[2].y := 30; WObj[2].z := 0;
    WObj[3].x := -30; WObj[3].y := -30; WObj[3].z := 0;
    WObj[4].x := 30; WObj[4].y := 30; WObj[4].z := -60;
    WObj[5].x := -30; WObj[5].y := 30; WObj[5].z := -60;

    {---assign drawing variables---}
    Dist := 1200;    {distance to picture plane}
    {YawRad := Deg2Rad(0); RollRad := Deg2Rad(0); PitchRad := Deg2Rad(0);}
    TransX := 0; TransY := 0; TransZ := 350   {Obj beyond picture plane}
  end; {initWorld}

  procedure GetParams;
  begin
    RestoreCrtMode;
    writeln('GraphWld.tpu Demo - Copyright (C) 1989 by Gene Fowler');
    writeln;
    writeln('Only the 3 rotation params to be set, not the plane and');
    writeln('object distances, translations, or placement of the two face');
    writeln('semi-cube. This side is centered on x0,y0 and all four points');
    writeln('have z = 0 - so a 90 degree yaw with 0-roll,0-pitch shows a');
    writeln('straight line. Enter all three 0s when finagling world...to');
    writeln('have an expected square for test measuring. Aspect is in world.');
    writeln;
    write('Yaw angle in degrees (0-360):  ');
    readln(YawRad);
    YawRad := Deg2Rad(YawRad);
    writeln;
    write('Roll angle in degrees (0-360):  ');
    readln(RollRad);
    RollRad := Deg2Rad(RollRad);
    writeln;
    write('Pitch angle in degrees (0-360):  ');
    readln(PitchRad);
    PitchRad := Deg2Rad(PitchRad);
    SetGraphMode(GetGraphMode)
  end;

  begin  {main}
    DirectVideo := False;
    InitWorld;
    repeat
      {set rotations, draw, and view}
      GetParams;
      AdjustParams;
      ConstructModel;
      WritePressKey;
      repeat until keypressed;
      GoAgain := ReadKey; {clear key}
    {repeat or quit choice}
      RestoreCRTMode;
      write('Repeat or quit (r/q)? ');
      repeat until keypressed;
      GoAgain := ReadKey;
      SetGraphMode(GetGraphMode);
    until (GoAgain = 'q') or (GoAgain = 'Q');
    CloseGraph
  end.
```


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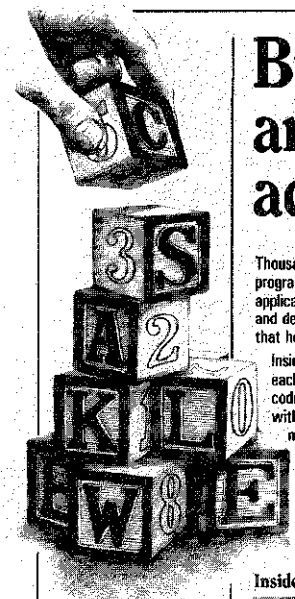

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Numeric Extensions, Zortech C++, and ANSI C

by

Rex Jaeschke

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In this installment, I'll introduce you to a significant new C standards activity I recently launched, and I'll tell you how Zortech's C++ compiler performed in my ANSI conformance tests.

Numerical C Extensions Group

For some time, I have had an interest in standardizing extensions outside of X3J11. Thus far, my role has been to convene an extensions meeting one evening during each X3J11 meeting week. And while each extensions meeting was well attended, only the two or three regular presenters really participated.

In September 1988, we at X3J11 decided we had done the best job we could and voted to forward the standard to X3 for final approval; although that approval has not yet been granted, all indications are that it *will* be without further committee deliberations. As a result, the X3J11 meetings will be held less regularly and for shorter periods. That, coupled with many of the regular X3J11 attendees having little or no interest in the numerical marketplace at this time, makes X3J11 an inappropriate forum for efforts to standardize extensions, at least in the numerical direction.

Certainly, any effort to standardize extensions must be done with X3J11's stated goal and future directions in mind. One of the principal reasons complex and the like are not in the first version of the standard is the lack of prior art and, in some cases, the lack of *consistent* prior art. Only when an extensions group can form consensus within its own ranks can it reasonably expect a formal standards body to consider adopting the extensions.

As a result of my involvement in X3J11, my writing and teaching interests, and my starting *The Journal of C Language Translation* (a quarterly publication aimed at C language implementers), I have formed an extensions group. The broad purpose of this "Numerical C Extensions Group" (NCEG) will be to standardize extensions to the preprocessor, language, or library (as appropriate) to sell to the numerical community and satisfy the increasing interest in C being shown by that community.

Initially, NCEG should

- Identify existing hardware and software art.
- Identify existing and pending formal and de facto standards and establish a liaison with them. (X/OPEN, OSF, POSIX, X3J11, GKS, and ISO—and maybe even FORTRAN 8X—immediately come to mind.)
- Identify the technical issues and assign them to the appropriate priority categories:
  - Must have now or as soon as possible.
  - Can live without for the time being but eventually will need or would like.
  - Wishful thinking: "Gee, wouldn't that be nice stuff?"
- Recognize, accept, and rationally deal with the problems created when competing vendors and conflicting commercial interests arise.
- Identify, as soon as possible, those areas that such a group cannot, or chooses not to, standardize.

NCEG Meeting Report

[The following report is reprinted (with permission) from Volume 1, Number 1 (June 1989) of The Journal of C Language Translation, © *1989 Rex Jaeschke.]*

Introduction

When I conjured up the idea for an ad hoc group to define numerical extensions to C earlier this year, I had no idea what the reaction would be. The evidence is now clear that this endeavor is seen as being very worthwhile: Not only have more than 90 people asked to be added to the contact database, but 30 of them attended the one-and-a-half-day meeting at Cray Research on May 10 and 11.

The backgrounds of the attendees were diverse. The supercomputing industry was represented by Cray, Convex, Supercomputer Systems, and Thinking Machines. The IEEE community was well represented by Hough (from Sun), Cody (from Argonne Labs), and Thomas (from Apple). Other organizations represented included Unisys, Microsoft, Digital Equipment Corporation, Hewlett-Packard, CDC, IBM, Solborne, Farance, the University of Minnesota, Intermetrics, and Information and Graphics Systems. The digital-signal-processing industry was represented by Analog Devices, and LLNL, Army BRL, and Polaroid Corporation represented the user com-

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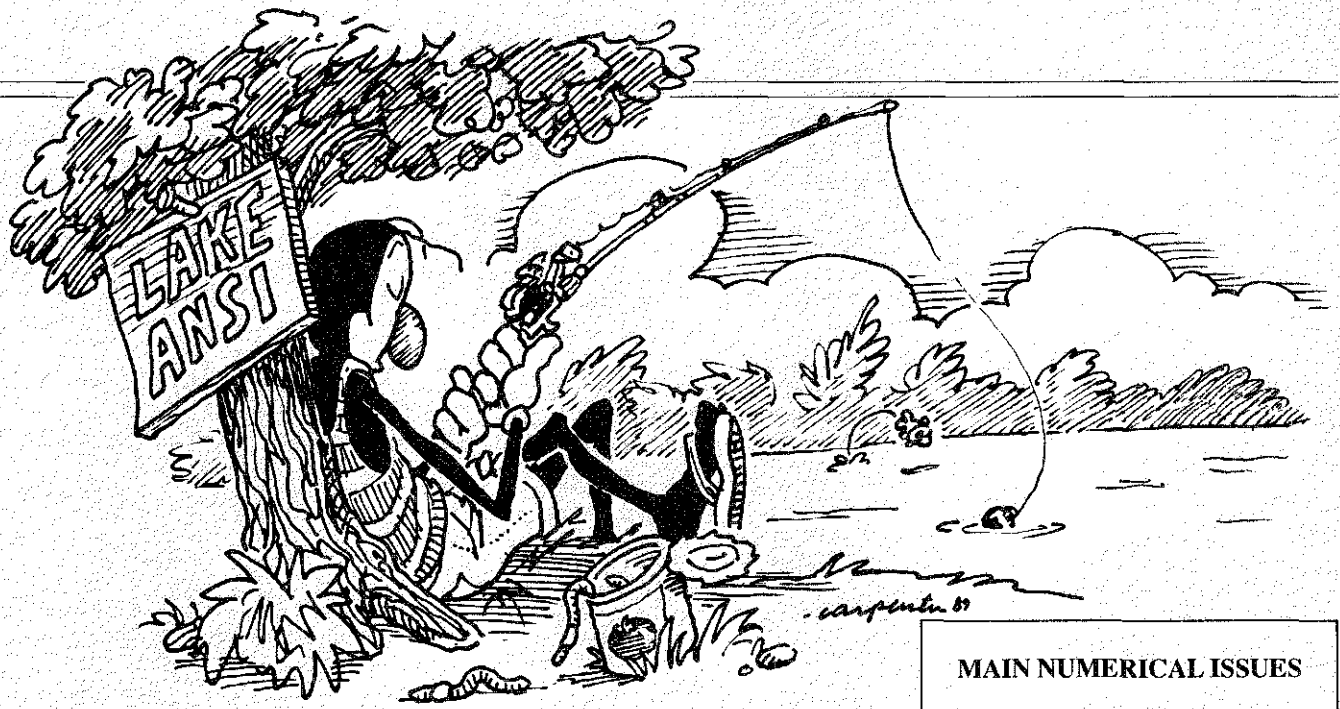

munity. Dennis Ritchie, from AT&T, also participated.

There was no real sentiment for deliberately going against the direction established by ANSI C; in fact, quite the contrary. However, it was recognized that some of ANSI C's constraints may impede our activities and result in possible conflicts. The whole issue of **errno** and formatted I/O of NaNs and infinity are examples.

The Issues

The main purpose of the meeting was to identify the principal technical issues. The group then voted on each topic, indicating high or medium (or no) priority. The high-priority votes were given twice as much weight as the medium-priority votes, and the list of priorities shown in the box resulted.

Another topic, arrays as first-class objects, had a high priority (21) but after considerable debate was dropped from the list since it was agreed that its addition would likely cause great confusion for C programmers.

Formation of Subgroups

The bulk of the agenda time was then given to the top ten topics, each getting 20 to 30 minutes. For each of these topics, attendees volunteered to be primary and alternate coordinators. (The minutes of the first meeting identify these people; in the interim, contact me for details.)

The intent is for the real technical work to go on between meetings and be coordinated by the leaders of each subgroup, and then, at the following meeting, to have each subgroup present the results of its work and make formal proposals as appropriate. This way, the committee can focus on the final, distilled issues rather than having everyone get involved at all levels. It will also significantly reduce the amount of paper in the mailings.

If you wish to participate in any of these subgroups, contact the leaders and identify yourself, your concerns, and how you can help.

Mailings and Submissions

Most of the people interested in NCEG appear to have e-mail addresses, which should make coordinating various viewpoints and proposals much easier for the subgroups. However, all formal distributions will be by paper mail. Since meetings are to be held once every six months, there will be two mailings between meetings. The first will occur within four to six weeks after a meeting and will contain minutes, new papers, and other appropriate correspondence. The second will occur about four to six weeks prior to the following meeting. The cut-off date for formal submissions for the September meeting was August 11.

Forward all correspondence to me (either by mail or via uunet!aussie!rex; note that I do not have a **troff** formatter) and I will assign it a document number. However, do so only if your paper is concerned with issues not being handled by a subgroup; forward subgroup-issues papers to the appropriate subgroup coordinators so that they can include them in their submissions to me. That way, we can avoid excessive duplication of points and allow the short meeting time to be used more effectively—the more formal documents we have, the slower it will go.

Tom MacDonald at Cray Research has agreed to do the mailings, at least for the interim. Frank Farance, of Farance, Inc., has volunteered to be the redactor of the group's working document. Thanks to Tom and Frank. Thanks also to Randy Meyers from

MAIN NUMERICAL ISSUES

Topic	Priority
Aliasing	29
Vectorization	27
Complex	27
Variably dim arrays	25
IEEE issues	24
Exceptions/**errno**	24
Float/long double library	23
Parallelization	22
ANSI <math.h>	21
Array syntax	19
Extra math functions	17
Aggregate initializers	15
Interlanguage issues	15
Wide accumulators	10
Math function precision	9
Non-zero-based arrays	8
Numerical representation	6
New data types	4
New operators	4
Function overloading	4

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DEC, who acted as meeting secretary, and to Cray, for being meeting host.

Formal Affiliation

There was consensus that we become affiliated with a recognized standards organization. The final proposal was that we become a working group within X3J11. If we follow that route, it will result in our publishing a "Technical Report," a nonbinding report on our findings and recommendations. Getting our extensions adopted as a standard is also possible, in the long term. At this stage, I plan to ask for agenda time at the next X3J11 meeting to discuss admitting us as a work group.

In the interest of economy, the next two meetings are scheduled in the same location and week as those of ANSI C's X3J11. These NCEG meeting dates are September 19 and 20, 1989 (Salt Lake City), and March 7 and 8, 1990 (New York City).

Zortech C++ V1.07

Recently, I took delivery of Zortech's C/C++ compiler and put it through my ANSI conformance tests. Although both a C and a C++ compiler are included in the kit, both of them define __STDC__ to be 1 when the *-A* strict ANSI switch is selected. Since I expect more Zortech customers use the C++ component than the C one, I tested only the C++ compiler.

The Compiler Options

The only option of importance here is *-A*, strict ANSI mode. Option *-J* is supported to make plain chars unsigned.

The Preprocessor

The following ANSI C attributes are not supported or have some limitation:

- Permits a macro to be redefined differently.
- Stacks different definitions for the same macro.
- Permits the five predefined macros and defined operator to be **#undef**ed and **#defined**.
- Mishandles some backslash–newline continuations.
- Doesn't diagnose extra tokens at the end of directive lines.
- Fails to diagnose an unterminated comment.
- Can't handle **#include /*...*/ <stdio.h>**.
- Should not permit floating-point constants, casts, or enum constants in **#if** arithmetic.
- Can't handle alternate form of defined operator (without parens).
- Permits **#if**, **#else**, and **#endif** directives to be in different files.

The following test gave a surprising result:

```
#define DEF2 #define
DEF2 M2 100
```

A macro named M2 was actually created with the value 100. This is not permitted by ANSI, since all directives must exist as preprocessing tokens in the original source file—you cannot "construct" a directive name during preprocessing.

The **sizeof** operator is permitted in **#if** arithmetic, although this is not required by ANSI C.

The preprocessor passed many more tests than it failed and, in general, is in pretty good shape.

The C Language

The following ANSI features are not supported or have problems:

- No auto-aggregate initializers are permitted.
- There is no f (or F) float constant suffix.
- There is no l (or L) long double constant suffix.
- Long float is accepted but should not be.
- There is no trigraph support.

All of these are very minor issues.

The Run-Time Library

Only one header is missing, **locale.h**. However, the following headers were

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incomplete or contained extensions that were not conditionally compiled out in strict ANSI mode: **assert**, **ctype**, **float**, **limits**, **math**, **setjmp**, **stddef**, **stdio**, **stdlib**, **string**, and **time**. That leaves only three headers that passed all tests: **errno**, **signal**, and **stdarg**.

Almost all of the headers use a protective wrapper to prevent their being **#included** more than once. However, the names used for the macros controlling this are in the programmer's name space. For example, **ctype.h** uses CTYPE_H when it should use something like _CTYPE_H or __CTYPE_H.

Numerous function prototypes were missing the **const** keyword. From the dates in the header comments, it appears that some are quite old and haven't been revised for several years.

The header **assert.h** cannot be **#included** more than once with **NDEBUG** defined and not defined, as is required.

The definitions for CHAR_MIN and CHAR_MAX in **limits.h** are hard coded and, thus, will not be correct when the *-J* option is used. In fact, as CHAR_MIN is currently defined, it is wrong. Header **limits.h** also contains some macros now defined in **float.h**.

In **setjmp.h**, **longjmp** is declared to return an int when it should return void.

Header **stddef.h** is missing some macros and typedefs and declares **errno** (an interim location in a previous draft of ANSI C).

Lot's of work is needed here.

The Bottom Line

The C part of the compiler seems to be quite solid, and it provides reasonable error handling, for the most part. Also, many of the tricky dark corners of the standard have been correctly implemented. In terms of tracking the draft ANSI standard, it's in the top 25 percent of DOS C compilers (along with Microsoft's and Borland's products). In terms of ANSI conformance, it's still quite a ways off, although all of the immediately useful stuff is there. It is not clear why __STDC__ is defined as 1, since that means "ANSI conformant," which clearly is not true. Perhaps it's marketing license.

Rex Jaeschke is an independent computer consultant, author, and lecturer. He is actively involved with the ANSI and ISO C Standards committees and is the convener of the recently formed Numerical C Extensions Group (NCEG), which is defining numerical extensions to ANSI C. Rex is the editor of The Journal of C Language Translation, *a quarterly publication aimed at C language implementers. You can contact Rex at 2051 Swans Neck Way, Reston, VA 22091, 703-860-0091, or via UUCP: uunet!aussie!rex.*

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386 Development Environments and Tools

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Nu-Mega Technologies has recently released version 2.0 of Soft-ICE, their powerful DOS debugger that uses the 80386 to provide hardware-debugging capabilities. On an 80386 machine, Soft-ICE can add some very sophisticated features to your favorite DOS debugger. These features are normally found only in hardware-assisted debuggers and In-Circuit Emulators (ICEs). These features include real-time breakpoints on memory reads/writes, port reads/writes, memory ranges, and interrupts. Soft-ICE also adds the ability to break out to the debugger with a keystroke even if interrupts are disabled and your application has taken over the keyboard interrupt. Note that Soft-ICE will work with real-mode programs only; it will not work with programs that use 80286 or 80386 protected-mode instructions.

Version 2.0 has added back-trace history ranges, EMS 4.0 support, extended-memory support, symbolic and source-level debugging, and an enhanced user interface. The back-tracing features provide a memory history of what your code executed, along with a trace simulation through your source. Version 2.0 now includes a full EMS 4.0 driver, plus powerful EMS debugging features. Soft-ICE now allows you to look at and modify all of the available extended memory, which is a very useful tool for debugging VDISK, CACHE, and other programs that make use of extended memory. The new user interface with version 2.0 now has separate Code, Data, and Register windows, programmable function keys, and "point-and-shoot" breakpoints. The new source-level features are somewhat limited, but they do provide the ability to debug device drivers, interrupt handlers, TSRs, and ROMable code more easily.

The actual debugger code is completed isolated from your executing real-mode code, preventing an errant program from modifying or destroying Soft-ICE, even if DOS is clobbered. This new version can be configured to back-fill base memory past 640K and use none of the lower 640K of lower memory for the actual debugger code. Soft-ICE can also be used as a stand-alone debugger with a soft-boot capability for non-DOS systems. Soft-ICE can be loaded as a device driver or invoked from the command line as a TSR. When loaded as a TSR, it may be later unloaded from memory, but it must be loaded as a device driver when installed with other drivers (VDISK.SYS, RAMDRIVE.SYS, HIMEM.SYS, EMM 4.0, etc.) that use extended memory using ROM BIOS calls and when using the new history, symbolic, and source-level debugging features. A utility program converts the link-map file into a symbol file with line numbers and public symbols for stand-alone debugging.

The real strength of this product is found in using it with your favorite symbolic debugger. Nu-Mega also offers a companion product called MagicCV that allows running Microsoft Codeview in only about 8K of DOS memory. But the real triumph for debugging is a brand-new product, MagicCVW, that runs Codeview for Windows in only 8K of DOS memory. These two products together (Soft-ICE 2.0 and MagicCVW) provide possibly the best of all worlds if you're developing Windows-based applications. Soft-ICE comes with a solid, 270-page manual with a decent index and a quick-reference card. MagicCVW comes with a short, 32-page companion manual. Soft-ICE is available for $386, and MagicCVW costs $199; combined, the two products are available for $499.

OS/286 and OS/386 Developers' Kits
Eclipse Computer Solutions
One Intercontinental Way
Peabody, MA 01960
508-535-7510

Eclipse, formerly A. I. Architects, has just released Version 2.0 of the OS/286 and OS/386 Developers' Kits. These products provide DOS extenders for both 80286- and 80386-based DOS machines. As I noted in previous articles, the Eclipse OS/386 is the DOS extender that is closest in implementation to native DOS. Version 2.0 is a major upgrade to both the 286 and 386 versions of their DOS-extender family. New features in Version 2.0 include an automatic configuration program, support for Virtual Control Program Interface (VCPI), reduced DOS-memory usage, enhanced memory management, easier interrupt support, virtual 8086 mode for DOS programs, greater machine compatibility, improved real- and protected-mode communication, and new language support.

The kernel is now installed as a TSR, which may be removed from memory when not needed. This speeds the loading of protected-mode programs during both development and use. The OS/X86 DOS extenders now adhere to the VCPI specifications, allowing them to run under Quarterdeck's DESQview 386, which provides multitasking capabilities. The VCPI adherence also provides for compatibility with other conforming DOS extender applications. The resident OS/X86 kernel can now be configured to use only about 40K of the lower 640K DOS memory space, freeing more memory for other real-mode applications and TSRs. New memory-management features include multiple heaps, automatic compaction, and control over where the protected-mode component of the kernel is loaded—below or above the 1-megabyte boundary. New memory-management service functions allow access to page tables, selection of low or high memory heaps, and control over compaction. Interrupt handlers may be easily chained to real-mode handlers or shared between parent and child tasks. The virtual 8086 mode is supported, allowing up to 900K of memory for DOS applications (paging is used). This new release is compatible with the widest array of 286-clone machines. A supplied setup program automatically tunes protected-mode applications for the optimum performance on 286 and 386 machines. New language support has been added for Borland Turbo C and Turbo Pascal, and support will soon be available for WATCOM C and the new Lattice C compilers. Microsoft C and FORTRAN, MetaWare High C, and older versions of Lattice C continue to be supported. Lahey FORTRAN uses OS/X86 for their extended-memory FORTRAN compilers.

The OS/X86 DOS extenders support a powerful Remote Procedure Call (RPC) mechanism that facilitates communicating with real-mode code, such as graphics (samples for Halo and GSS are provided), communications, and so on. This mechanism has been enhanced, allowing RPCs to be written in C (Microsoft C is currently supported) rather than assembly language. Both DOS extenders come with a powerful debugger CP that provides a sophisticated EMACS-style editing environment for the command line along with loadable macros for symbol substitution. A utility converts a link map or object file into a symbol file suitable for use with CP, providing symbolic debugging.

Continued on page 91

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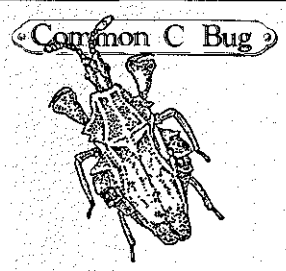

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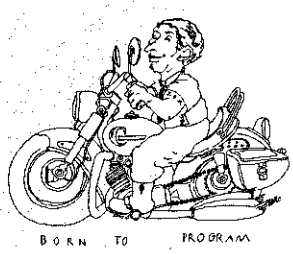

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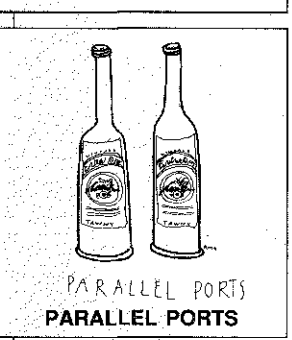

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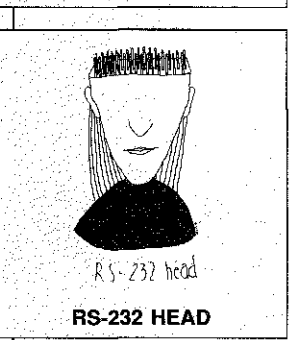

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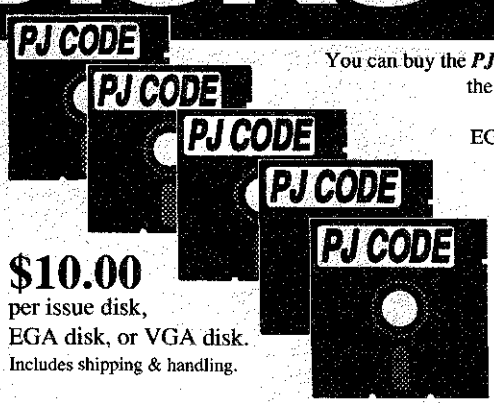

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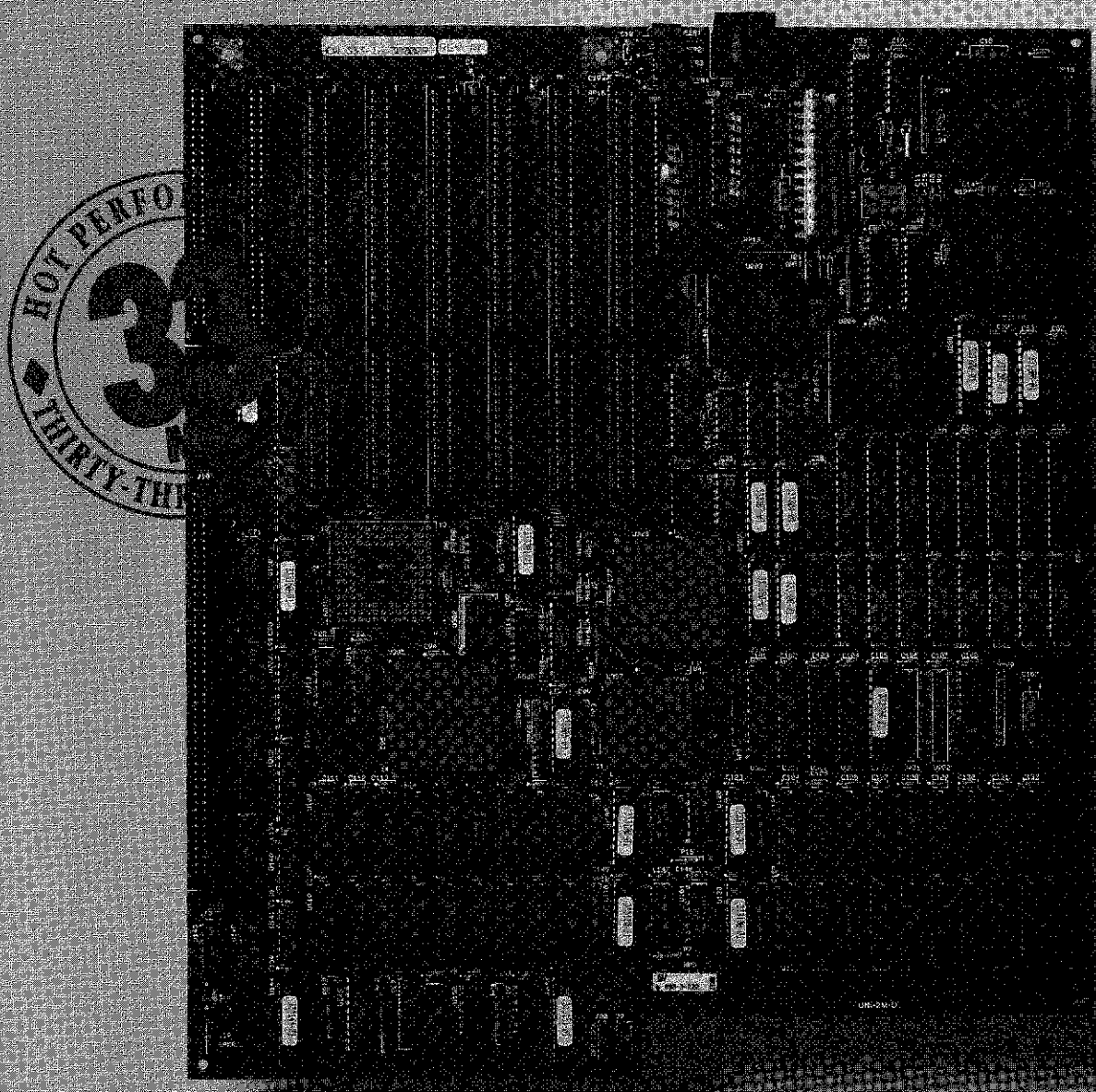

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The new OS/X86 versions come with a newly revised and expanded manual with a decent index. Eclipse provides technical support and has maintained a bulletin board for some time. The run-time license fee structure of this new version has been dramatically modified, making OS/X86 much more attractive for small developers: For an installed user base up to 2,500, the run-time license fee is just $10—total, not per copy. For 2,500 to 10,000 users, the license fee is fixed at $1,500. The OS/286 Developers' Kit is specially priced at $195 through September 30; $495 thereafter. If you've been planning on trying out a DOS-extender environment for your growing application, OS/286 or OS/386 just might be the ticket.

FTN77/386
OTG Systems
P.O. Box 239
Clifford, PA 18413-0239
717-222-9100

If you haven't yet heard, there is another 80386 FORTRAN compiler on the block. OTG Systems has been marketing FTN77/386, a 386 FORTRAN compiler developed at the University of Salford, in Great Britain. FORTRAN compilers from the University of Salford have been available on minicomputers for some time. Their Prime minicomputer FORTRAN compiler has a better reputation than a similar product developed by Prime. This is their first foray into the PC arena. FTN77/386 uses a DOS extender also developed at the University of Salford. FTN77/386 supports the 80287/80387 math coprocessors required for operation. Weitek support is not currently available.

These 386 development tools (compiler, linker, debugger, etc.) form quite a complete development environment. For instance, all these utilities have an on-line help facility built in. The 386 DOS-extender run time is installed as a TSR and contains much of the FORTRAN and DOS run-time libraries. The compiler supports a load-and-go option for quick testing. Compile speeds are very fast, equal to the fastest 386 FORTRAN compilers from Lahey and SVS. The compiler provides a large number of options supporting many FORTRAN extensions and some useful debugging aids. These aids include run-time checking of array subscripts, arithmetic overflow, and argument-consistency checking. In addition, variables and array elements can be checked to be sure that they are given a value before being used. Language extensions include long names, various data types (e.g., INTEGER*2, INTEGER*4, LOGICAL*2, LOGICAL*4), a WHILE statement, and very extensive subroutines, intrinsic functions, and internal procedures.

The compiler also supports an in-line 80386 assembly language syntax of limited power. A large number of DOS and PC-system routines are already provided. The in-line assembler and large set of DOS-support routines are really mandatory, since the 386 DOS extender provided is not supported by any of the other 386 development tools from, say, Phar Lap (80386 assembler) and MetaWare (386 C compiler). Included are support routines for bit handling, storage management, character handling, screen/keyboard, time/date, file manipulation, command-line parsing, and window manipulation; graphics, mouse, in-line, and miscellaneous routines are also provided—a very rich set of primitives for a FORTRAN compiler.

Contrary to what may have been written in an earlier *Computer Language* review, the compiled FORTRAN executable code is about average in speed for 386/387 compilers. INTEGERs default to INTEGER*2, and so *Computer Language*'s results for Whetstones are significantly overrated (INTEGER*2 values truncate the loop counts in the Whetstone benchmark). Also, FTN77/386 lacks a LOGICAL*1 data type, which may pose problems when porting from VAX or other minicomputer FORTRAN code. Documentation consists of a solid manual of over 200 pages with a decent index. Documentation on DBOS (their 386 DOS extender) is somewhat limited, and I figured out quite by accident how to unload the 386 run-time TSR from memory. FTN77/386 is available for $1,095, and the run-time is available for distribution with your application, in blocks of five, for about $50 per copy. The largest limitation of this product is that the 386 DOS extender supplied is of OTG's own design and so is not supported by other 386 development tools (such as macro assemblers and C compilers).

Mini-Case Tools

CC-RIDER
Western Wares
Box C
Norwood, CO 81423
303-327-4898

Western Wares has released both DOS and OS/2 versions (1.2) of their CC-RIDER package. CC-RIDER consists of a sophisticated C source file symbol analyzer, which creates a database for your C source, along with a powerful pop-up symbol cross-reference utility usable from within your favorite editor. The symbol analyzer (CCSYM) performs a complete syntactic parse of your C source code application modules, as well as of any #include files necessary for compilation. The symbol parser is compatible with the proposed ANSI C standard and also supports extensions used by Microsoft and other C compilers, such as near, far, pascal, interrupt, and cdecl.

CCSYM reads your C source and include files as input, like a compiler, but instead of producing object code, CCSYM analyzes your C symbols. CCSYM can produce a

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complete log file of your system's modules, headers, and symbols. The log file reports statistics on usage of symbols—macros, functions, structures, unions, enums, typedefs, and so on. CCSYM generates function prototypes conforming to K&R C or the newer ANSI C prototype style.

CCSYM can also generate or update a special symbol database containing information on macros, typedefs, functions, variables, structures, enums, and so on, used by a series of C source files. Once created, this database can be used by CC-RIDER, the pop-up editor utility. Wildcards are supported on the CCSYM command line, allowing you to generate a complete database file in one invocation. A list of input files can also be read from a file.

I found the CCSYM parser to be pretty robust: It stumbled on some nonstandard C code (#ASM directives) but continued parsing the file without aborting. Include files are found using the INCLUDE environment variable. CCSYM does not gather statistics on auto (local) variables declared within a function.

CC-RIDER provides instant access to all macro, typedef, scalar, function, structure, union, and enum definitions from within your favorite editor. To look up a symbol, just move the cursor into the word of interest and activate CC-RIDER with a hot-key sequence (which defaults to Alt+Left-Shift for convenience). If a definition exists for the symbol, a larger window will appear, showing the symbol definition. At this point, you can choose to view the original source file where the definition was found and even scroll around in this file. Cut-and-paste features are available. When you're done viewing information, pressing a return key or two will restore the screen and put you back into your favorite editor.

The CCSYM utility executes reasonably fast and allows incremental updates to the symbol database. The DOS version of CC-RIDER (the pop-up TSR) requires about 150K of memory, which appears excessive, given the application. The OS/2 version uses some OS/2 monitor features and acts as a multifunction application. Both versions come with a short, 42-page manual with a decent index. I found the pop-up utility quite well implemented and very useful—a way to simulate hypertext editing within your own favorite editor. The DOS version costs $89, while the OS/2 version costs $179.

EasyFlow
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HavenTree Software has released Version 6.0 of EasyFlow, an on-screen interactive graphics program designed to compose and modify charts and diagrams easily. While other programs may generate diagrams from your existing code, EasyFlow can be used by programmers to generate design flow charts and data flow diagrams *before* the actual coding begins. This new version has a number of enhancements that will benefit programmers.

EasyFlow is not simply another graphics program that draws boxes and connecting lines. The program has extensive charting knowledge built in and takes much of the burden from making flow charts and diagrams. Some of these features include automatically routing lines, automatically centering text within shapes, and automatically placing text blocks along lines. While the program works fine with only a keyboard, a mouse is fully supported.

While previous versions supported only shapes used for flow charts, this new version now supports data-flow diagrams. Chart shapes are organized in three separate libraries: flow charts, data-flow diagrams, and organizational charts. The shape libraries cannot be mixed. You create charts by placing shapes, lines, and text on a scrollable screen. Hercules, CGA, EGA, and some enhanced-color video cards are supported. In a 640K machine, the chart size is limited to about 300 shapes, but EasyFlow can be configured to use expanded memory to increase the maximum chart size. The flow chart shape library sports 34 different shapes, about one-third of which are available in three sizes. Dot-matrix, LaserJet, and PostScript printers are supported as output devices. Plotters from Hewlett-Packard and Houston Instruments can also be used for output.

EasyFlow makes extensive use of the function keys (or the mouse menus and buttons) for chart editing. The drawing screen is divided into a narrow vertical window displaying the chart status, commands, and expanded view of the current chart element and a large, scrollable window for the entire chart. Zoom-in and -out commands are supported. Text can be placed either inside a shape or along a line. The chart editor supports block operations, such as move, copy, cut and paste, saving to disk, and loading chart fragments. EasyFlow also has an optional grid snap, like that of CAD programs, to align shapes. I also appreciated the ability to turn *off* the error bell. I wish more programs were this configurable.

The main-menu front end also includes such utilities as a file manager and an export utility. The export utility allows converting a saved EasyFlow chart to any of the following file formats: CGM (Computer Graphics Metafile), AutoCAD DXF, EPS (Encapsulated PostScript), GEM (used by Ventura), PLT (Hewlett-Packard HPGL), and TIFF (Tagged Image Format). The accompanying manual is very well written, with excellent illustrations and about the most detailed keyword index I've seen in a long time. If you need a tool to help you organize your thoughts before you start coding, EasyFlow could prove useful.

Books

Algorithms **by Robert Sedgewick**
Addison-Wesley Publishing Company
1 Jacob Way
Reading, MA 01867
800-447-2226
$40.95

This is the second edition of a fine book on algorithms. The author had Donald Knuth of Stanford as an advisor, through which his interest in algorithms was piqued. The first edition was a clear, well-written exposition on algorithms; in this edition, the writing is even clearer. The revised text is accompanied by hundreds of figures for visual clarity.

The focus of the book is on algorithms likely to be of practical use. The text is organized into eight major sections: Fundamentals, Sorting Algorithms, Searching Algorithms, String Processing, Geometric Algorithms, Graph Algorithms, and Advanced Topics.

The first section covers elementary data structures, trees, recursion, analysis of algorithms, and the implementation of algorithms. The section on data structures briefly covers arrays, linked lists, storage allocation, pushdown stacks, queues, and abstract data types. These chapters do an excellent job of introducing the topic in an organized and easy-to-read manner, and they set the tone and form a solid basis for the guts of the book—chapters on various algorithm types and their implementation.

The programming examples are provided in Pascal source code. Sorting and searching are well covered. Sorting methods described include selection sort, insertion sort, bubble sort, shellsort, quicksort, radix sorting, heapsort, mergesort, and external sorting. Some topics are covered at greater depth than others. For example, the chapter on quicksort, aside from implementing the basic algorithm, shows how it is possible to remove recursion. Various tree structures are described for searching—binary trees, indirect binary trees, top-down trees, 2-3-4 trees, red-black trees, and B-trees. I would have liked to see a more detailed discussion and implementation of B+ tree structures, since these are almost universally used for indexing in PC database applications. The coverage of string processing is solid, including brute-force methods, Knuth-Morris-Pratt, Boyer-Moore, Rabin-Karp, and multiple searches. The section on file compression is a bit weak, covering run-length encoding, variable-length encoding, and an implementation of Huffman code. The now common Limpel-Zev-Welch (LZW) algorithm is not mentioned. The sections on geometry, graphs, mathematical algorithms, and advanced topics are well done. Overall, I found this text a solid reference book for my algorithm shelf, and maybe you will, too.

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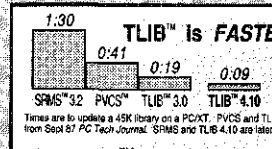

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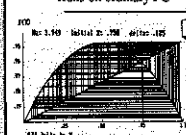

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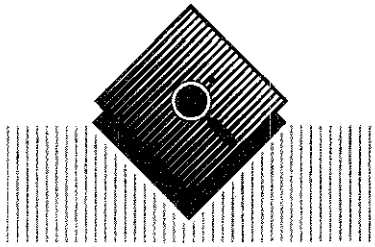

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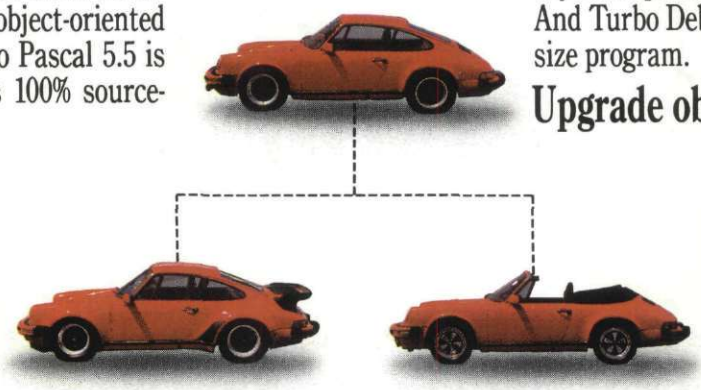

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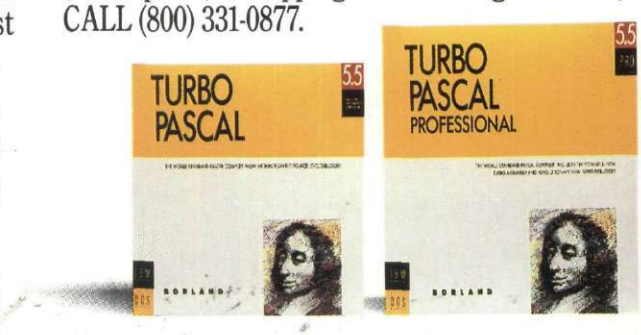

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